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TYPES OF READING ABILITY AS EXHIBITED THROUGH TESTS AND LABORATORY EXPERIMENTS

AN INVESTIGATION SUBSIDIZED BY THE GENERAL EDUCATION BOARD

By

CLARENCE TRUMAN GRAY

UNIV. OF CALIFORNIA
SOUTHERN BRANCH

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CHAPTER I

INTRODUCTION

THE PROBLEM

The fact that great individual differences exist in the ability of pupils in reading has been known by practical teachers since instruction in reading first began, but the effort to give scientific descriptions of these differences is a matter of very recent years. As soon as definite tests of reading are applied in schools, it appears that individual differences are very striking. Thus it will be shown in detail through some of the tests in oral reading that certain high-school pupils cannot read with success selections which many fifth-grade pupils read fluently and with understanding. Furthermore, one test in silent reading has shown that some pupils in the sixth grade read silently at the rate of 1.5 or 2 words per second, while others in the same class read the same selection at the rate of 5 or 6 words per second. These differences in rate exist in spite of the fact that school authorities have classified these pupils together as able to do the same school work and in spite of the fact that in most cases such pupils have had the same school training in reading.

The discovery of such variations leads at once to the demand that their causes be discovered. Doubtless some of the differences are inherent in the mental character of the pupils, while others are due to the training in reading which the individual has had. If these differences are made the basis of experiments in training, it is found that in some cases large changes can be brought about, while in other cases training seems to have little or no effect. Where differences between pupils can be traced to methods of training, it is often a simple matter to suggest changes in methods of instruction which will be of advantage.

The general types of methods for studying individual differences in reading have been reported in the literature on this subject. The first type consists in a careful and detailed experimental

investigation. Illustrations of this type of work may be drawn from Messmer's (28)[1] work in perception or the work of Erdmann and Dodge (11) in eye-movements. It is of interest to note that this method is historically much older than the second method to be described. It is also true that this experimental method has been developed in psychological laboratories by men who have had only secondary interest in the educational bearing of the results. Attention should be called to the fact that in nearly every case the subjects who took part in these experimental investigations were adults rather than children. For students of educational problems this fact gives rise to a very serious difficulty in interpreting the results.

The second type of method is of recent origin and has been developed and used by those who are interested in educational problems. It consists in the employment of tests by means of which ability in either oral or silent reading may be determined. These tests are commonly used with a large number of children, and the results are compiled so as to determine norms and to show the characteristics of groups rather than of individuals.

The net result of the work which has been done in reading by these two types of methods is a considerable body of information concerning certain phases of the reading process. This information is, however, of a very general type and has never been put in a form which makes possible a careful diagnosis of an individual pupil. Indeed, much of it is too general to be applied directly to the case of a single pupil. The present investigation may be described as an attempt to use all the results now at hand and to develop new methods which will lead to accurate accounts of the reading process of single individuals. To be sure, Messmer's work has aimed in part at a like result and gives information about the perception of certain individuals; but nothing is known of their oral- or silent-reading ability, and Messmer has not employed at all the laboratory method of recording eye-movements. Other authors, also, give incidental observations on individuals, but undertake no systematic study of the reading process. The field of investigation is therefore comparatively unoccupied.

[1]Numbers in parentheses refer to the bibliography, to be found on pp. 168 ff.

The methods employed in the present inquiry are various, many of them being borrowed directly from earlier workers. The first chapter of the report will therefore be devoted largely to a brief summary of earlier studies which have been used in the course of the present inquiry.

EARLIER INVESTIGATIONS

The investigations which are to be included here divide themselves into three distinct groups. The first group deals with visual perception. Many of the studies of this mental activity have a direct bearing on the reading process. The first results in this field were really a by-product of reaction-time experiments and were procured by men who at the time were not interested primarily either in perception or in reading.

Investigations of the second group concerned themselves with certain motor processes related to reading. The work of Erdmann and Dodge (11), which has been mentioned in another connection, will serve as an illustration of this group.

The third type of investigation tested the results of instruction. This kind of work has been mentioned in another connection and need not be discussed further at this time.

VISUAL PERCEPTION

One of the most important problems which has been investigated in studies of visual perception is the determination of the unit of perception. The question here raised is as follows: How long does it require for an observer to recognize a unit percept, such as a word or a letter? The first results were obtained by Exner (12) and Baxt (2). These early writers did scarcely more than call attention to the problem. The first conclusive evidence given upon this point is the work of Cattell (4), which was done in the laboratory at Leipzig. He exposed letters, phrases, and sentences by means of a fall chronometer. His conclusion was that perception in ordinary reading does not proceed by letters, but by words and, in some cases, even by phrases or sentences. He reached this conclusion because he found that the time required for the recognition of a word was no greater than that for a letter.

In the cases where sentences or phrases were exposed he observed that sometimes they, too, were grasped as units.

This work of Cattell (4) was later confirmed by the work of Erdmann and Dodge (11). These authors based their conclusions upon a large number of exposures and have shown that words may be recognized when the individual letters are too small to be identified or when parts of the word are out of the range of clear vision. Each of these investigations is important because of the bearing which it has on the teaching of primary reading. Present-day methods of teaching begin with either the sentence or the word, and doubtless the investigations referred to have had much to do with making the new methods acceptable.

Another perceptual problem which has received careful attention is that of the grouping or arrangement of impressions. Goldscheider and Müller (15) were the first investigators in this field. They showed that, if several straight lines in various arrangements were exposed for a very short time, the greatest number that could be recognized was four or five. If these lines were arranged in some regular or symmetrical form, however, the span of perception was increased to seven. The same general principle holds with regard to geometrical forms, such as squares, rectangles, etc. Later Erdmann and Dodge (11) established the same general principle for language forms. That is, words are readily distinguished when written or printed on a horizontal line, but are not readily recognized if printed in a vertical column, although the order of the letters may be the same. Freeman (14) has shown that the same law holds with regard to number groupings. All of these researches indicate clearly the value of the general form for perception and show how necessary it is for primary teachers to know the characteristics which differentiate words as wholes and which enable children to perceive them.

A third problem in the general field of perception is the determination of the value of different letters. Goldscheider and Müller (15) have named certain letters "determining" letters and others "indifferent" letters. By this is meant that certain letters may be omitted from a word, and yet such a word may be easily recognized. To illustrate, if the word "letter" is written *l-tt-r*, there is

little difficulty in the recognition of it. In this case *e* would be the "indifferent" letter, while the others are "determining" letters. Although both vowels and consonants belong to each class, consonants probably are the "determining" letters more often than vowels, because they extend above and below the line. The work of Zeitler (45) confirmed these results. He uses the term "dominating" instead of "determining" and emphasizes the fact that in perception these "dominating" letters serve as points for the fixation of attention, while apperception fills in the remaining space.

The relation of the form of the different letters to perception is discussed by Messmer (28). He distinguishes three significant characteristics in letters: first, the breadth of the letters; second, their height; and third, their geometrical form. The first of these characteristics is illustrated by the difference in width of such letters as *n* and *m*, or *v* and *w*. It is the opinion of this author that this characteristic of letters has little, if anything, to do with perception, because it disappears in the total impression of the word whole. The second characteristic of letters is illustrated in the difference in height between *a* and *h*. Messmer argues that some letters break up the word into sections. Attention may be called to the difference between such words as "philanthropy" and "consciousness." Evidently the first of these words is much broken up, while the second is monotonous. The last characteristic of letters is illustrated by the entirely different geometrical forms of the letters *o* and *w*. Messmer (28) divides letters with regard to geometrical form into three groups: first, those made of vertical strokes, such as *i*, *l*, and *h;* second, those composed for the most part of curved lines, as *o*, *c*, and *a;* and third, those which have a combination of the first and second forms, as *b* and *d*. Messmer finds that different readers make very different use of the percepts derived from letters. He distinguishes two groups of readers—objective readers and subjective readers. The first group is composed of those who depend on the "dominating" letters in their recognition of words. This means that their attention is fixed upon details, that they take in little in a single act of perception and as a result make few mistakes. On the other hand, the

subjective group is made up of readers who do not depend in any great degree upon perception of the details of the word, but supply a large part of the percept out of their interpreting power.

Huey (21) found that the first half of a word has more value for perception than the latter portion. He also points out that the upper portion of a word is more important for perception than the lower portion.

The earliest investigators in the field of the relative legibility of different kinds of printing were Griffing and Franz (19). They found that the larger types are in every instance more legible than the smaller types, and that Gothic letters are more legible than Roman letters. Cattell (4), in his short-exposure work, found the descending order of legibility for capitals to be as follows: *W-Z-M-D-H-K-N-X-A-Y-O-G-L-Q-I-S-C-T-R-P-B-V-F-U-J-E.* This order was changed very much for lower-case letters. Sanford (37) and Finzi (13) also worked on this problem. Their method was the same as that used by Cattell. The kind of type was different in the two experiments, hence the results are not comparable. More recently Roethlein (34) reports an extensive investigation on the legibility of various kinds of type. Her results indicate that legibility is a product of six factors: first, the form of the letter; second, the size of the letter; third, the thickness of the lines which constitute the letter; fourth, the width of the white margins which surround the letter; fifth, the position of the letter in the letter group; and sixth, the shape and size of the adjacent letters.

The effect of practice on the span of perception has been investigated by Whipple (44). He exposed non-sense material and digits with a short-exposure apparatus. His conclusion is that with such material there is no improvement except that which can be explained by the fact that the subjects become accustomed to the experiment and learn certain "tricks" by which they can remember. Whipple gives the following conditions on which efficiency in visual apprehension seems to depend: first, native capacity for concentration; second, degree of attention; third, the type of material; fourth, ease of assimilation; fifth, obstructions and distractions; sixth, ideational types; seventh, restrictions; and eighth, grouping.

Closely related to the effect of practice on the perceptual span is its increase with age. Griffing (18) has shown that from the seventh to the eighteenth year there is a gradual increase in the percentage of digits perceived visually. The method of this author was different from the usual method of giving short-exposure tests, in that he varied the time between the "ready" signal and the exposure from 6 seconds to 1.5 minutes, without the knowledge of the subject, with the idea of testing the subject's power of prolonged attention. This variation in method makes rather doubtful the use of his results in connection with the others here reviewed.

Another problem for consideration is that of the range of distinct vision in its relation to reading. This problem was first attacked by Ruediger (36). Other investigators had concerned themselves with the field of peripheral vision, but Ruediger set himself the problem of determining how far from a central point of fixation the two letters *n* and *u* could be recognized. His results were obtained by the use of the fall chronometer. His conclusion was that there is no relation between the span of vision and the rate of reading. He called attention also to the fact that the rapid readers do not make use of their entire span of distinct vision. A second investigator in this field is Dockeray (9). He found that the span of distinct vision for letters in ten-point type at a distance of thirty-five centimeters from the eye is from twenty to twenty-two millimeters. He concludes also that in ordinary reading all the letters read must come within the field of distinct vision, and that probably the fields of distinct vision overlap in successive fixations.

Quantz (33) approached the problem of the span of perception by shutting out the perceptual field while a reader was reading orally. He put a card over the page of reading matter at some predetermined point while the reading was in progress. The reader was expected to go on reading as far as possible. Quantz's results show that much depends upon the place in the line at which the view is obstructed. If the view is cut off at the beginning of the line, an average of 7.4 words are seen in advance; in the middle of the line, 5.1 words in advance; while at the end only 3.8 words are seen.

This author also reports a high correlation between the number of words perceived ahead of the voice and the rate of reading. It is especially important to keep in mind these results because they draw attention to the fact that the reading process, when once under way, is very different from the reading of single words or reading at the beginning of a line.

The foregoing summary of investigations of perception shows that not less than eleven problems in visual perception have been attacked experimentally. Those which seem to relate directly to the problem at hand are as follows: (1) perceptual span, (2) effect of practice upon the visual span, (3) range of distinct vision, and (4) eye-voice separation in oral reading.

With the exception of the last of these problems, each one has been investigated by means of short-exposure apparatus. In most cases the apparatus used to give the short exposure consisted of a falling plate. In the experiment of Whipple (44) the short exposure is procured by means of a moving disk. Both types of apparatus are open to objections for use with children on account of the distraction which results from the moving of the parts. In the work of Dockeray (9) the Dodge mirror apparatus was used. If an adequate lighting system is provided, this apparatus lends itself well to work with children. For the fourth type of experiment the method which Quantz (33) used was very crude. The results are suggestive, and the experiments should be repeated with better technique. Furthermore, Quantz might have extended the same type of investigation to silent reading. In that case it would be necessary for the subject to note introspectively the point at which the reading material disappeared and to give as many words as possible beyond that point. Such introspection is complicated and can be used only with adults.

MOTOR PHASES OF THE READING PROCESS

Under motor phases of the reading process three different types of investigation have been carried on. The first of these gives results concerning eye-movements during reading; the second is concerned with the relation between oral reading and breathing; while the third gives results on vocalization during silent reading.

Eye-movements.—Four methods have been used in investigating eye-movements. Javal and Lamare (26) attached a delicate microphone to the eyelid and were thus able to hear the sudden stops of the eye. This is known as the acoustic method. Erdmann and Dodge (11) observed the movements of the eye by means of a mirror or telescope. Huey (21) used the method of attaching a lever to the eye and recording the movement on a kymograph. While each of these three methods is very crude in its technique, the results correspond very closely to those obtained by the fourth method. The most highly refined method and that which has given the best results is the photographic method. Dodge (10), Dearborn (8), Huey (21), and others have used the method of photographing the movements of a beam of light reflected from the cornea of the eye. This method was criticized by Judd (22), who thought it better to use a white spot on the cornea. However, Dodge (10) has presented data by both methods and has shown that the criticism is valid only in part.

Three types of movements of the eye appear in reading. First, there is the movement across the page, which proceeds by a series of short rapid movements, followed by pauses long enough to permit perception. Secondly, there are a small number of regressive movements which must be interpreted to mean that the eye has gone too far and must move backward and refixate. Thirdly Dearborn (8) reports a slight wavering movement which in many cases seems to be very like movements of the first type.

An important question which has been much discussed in the papers on eye-movements is the question whether there is perception during eye-movements. The preponderance of evidence seems to indicate that there is no perception during movement.

The number, length, and location of the pauses which the eye makes in each line of reading material present subjects for study. Large individual variations exist, depending on the rate of the reading and on the subject-matter read. Dearborn (8) calls attention to another factor which helps to determine the number of pauses. This is the motor habits into which the eye falls as different lengths of line are read.

Breathing and oral reading.—The work which has been done in relation to breathing and oral reading is limited. Scripture (38) has reported the fact that any word or phrase is uttered with a single continuous action and is not broken up into units corresponding to the written elements. Sweet (41) says that the only breaks made in language are those made by the breath pauses which have a close relation to the logical units of our language. Wallin (43) has called attention to the fact that the average number of syllables between these breath pauses is only about six. Scripture (38), also, has called attention to the fact that the utterance of any word calls into play three different sets of muscles: the muscles of the chest, which control respiration; of the larynx, which produce sound by making the vocal cords tense; and of the tongue, jaws, and palate, which modify the sound.

Some tentative results along this line, which were reported by the author of this investigation (16) in an earlier paper, were based on the pneumograph records of about forty children. Two of the conclusions were that there are sex differences and that there are decided differences for different school grades.

Inner speech and reading.—The last problem to be considered here is that of inner speech during reading. In discussing this point Meumann (29) suggests four questions, as follows: first, whether we must have inner speech in order to understand words; second, whether inner speech is purely acoustic, or motor, or both; third, whether inner speech is always present; and fourth, whether inner speech has any real significance for reading. Meumann's questions are of great importance to the psychologist who is concerned with the theory of perception. For our purposes these questions are of importance only in so far as inner speech affects rate and comprehension. On these problems the experimental evidence is limited. Secor (39) has shown that persons can read while they whistle, even though it must be assumed that whistling interferes with inner reading. Huey (21) tested thirty persons and in each case found that inner speech played some part in reading. These experiments show that inner speech is a combination of auditory and motor elements. Dodge (10) has noted that

inner speech is a very much shortened process as compared with speaking aloud. Quantz (33) found that children always read with a large amount of lip-movement. This movement, however, disappears to a very large degree with practice. Messmer (28) holds to the view that the auditory and motor centers work together in reading. Hansen and Lehman (20) found that, if a subject thought intently of a word, there was an audible whisper which could be heard if conditions were favorable. Curtis (7) procured objective records of some of the movements in articulation by means of a tambour placed over the larynx. In fifteen out of twenty cases he found movement, while in the remaining five cases the results were negative. This probably means that the apparatus was not sufficiently refined to get results in all cases. Courten (5) experimented with the movements of the tongue by means of a Rousslet exploratory bulb and reports that in every case he found movement. Pintner (31) trained two subjects to read silently at the same time that they counted out loud. This they were able to do after they had practiced counting the series 13, 14, 15, 16; 13, 14, 15, 16, etc., until it had become mechanical. His conclusions are as follows: first, that articulation during the reading process is a habit which is not necessary for that process; secondly, that, through practice, reading without articulation will be as good as the ordinary reading of the same individual, which involves some movement; thirdly that practice in reading without articulation tends to aid ordinary reading.

Without doubt each of the three types of experiments which have just been described should be included in any comprehensive analysis of reading. Later discussion will reveal the adaptations which have been made of each of the methods described above in order to render them available for this investigation.

MEASUREMENT OF READING ABILITY

Turning now to the last of the three fields mentioned at the beginning of this survey, we find two general problems to be considered—rate and comprehension in silent reading, and rate and accuracy in oral reading. The investigation of these problems has been carried on through certain tests.

The early investigators in this field were Romanes (35), Abell (1), and Quantz (33). They found very marked individual differences in the rate of reading. In testing for assimilation or comprehension they used the method of written reproduction. Abell (1) concludes that comprehension is independent of the rate of reading, while both Quantz (33) and Romanes (35) think that assimilation or comprehension varies with the rate.

In a recent publication on this general topic Thorndike (42) suggests various methods for testing reading ability. His tests deal, first, with the understanding of single words; secondly, with the understanding of sentences and paragraphs. The first test is one in which the pupil is expected to indicate the meaning of disconnected words in certain prescribed ways. The second test consists of two parts. In the first part the pupil is required to read paragraphs and to answer questions upon them in writing; in the second part he is directed to do a number of very simple things. Recently Thorndike has suggested a revision and refinement of this second test.

One of the most elaborate investigations of reading ability which has been made is by William S. Gray (17) and is reported in the Cleveland Survey. Tests were given in both oral and silent reading to several thousand children in the Cleveland schools. In oral reading both rate and errors were noted, while in silent reading the rate was noted and comprehension was tested both by questions and by reproduction. Contrasts between oral and silent reading were made, and graphs which indicate the development of reading ability through the grades were presented.

Another type of test for silent reading has been used by Starch (40). His method may be spoken of as the reproduction method. In tests of this kind the child is allowed to read a passage and, as a test of comprehension, is asked to reproduce the passage in writing. Additional work in silent reading has been done by Kelly (25), Oberholtzer (30), and others by methods not unlike those described above.

The most complete system of tests for oral reading is that worked out by William S. Gray (17). This consists of standardized paragraphs of prose material. The series of selections begins

with very easy passages and ranges to very difficult material. The child reads the selections orally, and the experimenter marks the errors made. In all of these tests the rate of reading may be taken into consideration by methods which are too obvious to need explanation. Gray has also standardized passages for use in silent-reading tests.

It may be noted that the use of standardized material makes possible a very wide range of comparisons which cannot be instituted with ordinary reading matter. Thorndike, Kelly, and Gray have attempted to standardize the material used in the test, while Oberholtzer (30) and others have used material found in the regular school readers.

The differences in degree of comprehension in silent and in oral reading are of interest at this point. This has been investigated by Mead (27), by Pintner (31), and by Pintner and Gilliland (32). Mead finds that, with the exception of one class, each of the classes investigated read in a given interval a greater number of lines silently than orally. He also states that, without exception, each class reproduced a greater percentage of possible points by the silent method of reading than by the oral method. In this connection Pintner (31) found that for fourth-grade pupils silent reading was the most economical. Pintner and Gilliland (32) give results for elementary and high-school pupils as well as for college students. The percentage of students who comprehended better by the oral and silent methods of reading, respectively, are shown in Table I.

TABLE I

DEGREE OF COMPREHENSION—ORAL AND SILENT READING

	College	High School	Grades		
			7–8	5–6	3–4
Percentage oral.....	20.0	40.0	50.0	46.6	63.3
Percentage silent	73.0	55.0	50.0	50.0	36.6

The tests of Courtis (6), also, should be mentioned here. They are of particular interest because these tests differentiate reading as normal reading and careful reading.

The work of Brown (3) marks a forward step in the study of reading in that it attempts to diagnose the difficulties of certain pupils.

There are a number of distinctions suggested by these papers but not fully worked out. Thus no attempt has been made to inventory the different types of comprehension used in the classroom. Certainly, comprehension as exhibited in answering questions and that shown in direct reproduction of what is read are not the only types of comprehension called for in school work. Children often have to reason about the material they have read. Again, the distinction between reading and study has not been drawn. It would seem that, if a pupil is given a complicated situation in a short paragraph and then is given time to think the problem out, there is more study than reading involved.

THE SUBJECTS

Such a study as the one to be reported in this monograph must necessarily be intensive rather than extensive, hence the number of subjects used is rather limited. Of the fifty-nine subjects studied, forty-one were selected from the Elementary School of the University of Chicago, ten from the University High School, and the remaining eight were women from the College of Education. In Table II is shown the age, grade, and sex of fifty-one of the subjects, the school in which their early training was received, and their marks in two studies other than oral reading. History was selected because it is a study in which a large amount of reading is required, and handwork was selected because it requires little reading. In the case where a history grade was not available a grade in geography was substituted. In the column for early training, U.E.S. means University Elementary School, C.P.S. means Chicago public schools, P.S. means parochial school, and Pr.S. means private school. The age is given in years and months. A means excellent; B, good; C, fair; D, poor; E, conditional; and F, failed.

The selection of the various subjects from the elementary and high school was determined by the results of a survey[1] of the

[1] The author is indebted to Dr. W. S. Gray for access to these results,

TABLE II

DATA CONCERNING SUBJECTS

GRADE	SUBJECT	SEX	AGE	GRADES FOR FIRST SEMESTER 1915–16				EARLY TRAINING
			Yr.-Mo.	Reading Ability	Oral Reading	Hand-work	History	
3	1	B	9–	P	C	A–	B	U.E.S.
	2	G	9– 6	M	B	B	A	U.E.S.
	3	B	8–10	M	A	C+	B	Pr.S.
	4	B	8–11	M	A	B	C	U.E.S.
	5	B	8–11	P	D	C–	A	C.P.S.
	6	G	8– 4	G	A	B	B	U.E.S.
	7	G	7– 9	G	A	B–	C	U.E.S.
	8	B	8– 9	P	D	C	C	Pr.S.
	9	G	8– 7	M	C	C	B	C.P.S.
4	10	B	10– 3	G	B	C	B	U.E.S.
	11	B	10– 5	G	B	A–	B–	U.E.S.
	12	G	11– 2	M	C–	C+	C–	U.E.S.
	13	G	11– 6	G	C–	C+	B	C.P.S.
	14	B	9– 3	P	E	B	A	U.E.S.
	15	B	11– 2	P	C–	B+	B–	Pr.S.
	16	G	9–10	P	C	B+	B	U.E.S.
	17	G	10– 8	P	D	B–	C	Pr. S.
5	18	B	11– 8	M	C	B	C	U.E.S.
	19	B	11– 5	M	C–	B	C–	C.P.S.
	20	G	10–11	P	C	C	D	U.E.S.
	21	B	10–11	M	C	B	B	U.E.S.
	22	B	11– 8	P	B	C–	C	U.E.S.
	23	G	11– 1	P	C–	C	D	U.E.S.
	24	G	12– 1	M	B	B+	A	Pr.S.
	25	G	11– 1	M	C–	B	C–	C.P.S.
6	26	B	13– 2	P	D	B	D	C.P.S.
	27	B	13– 7	P	C	B–	D	C.P.S.
	28	B	14– 5	M	C	B–	D	U.E.S.
	29	B	13– 2	P	C	B+	D	U.E.S.
	30	B	11– 6	G	B+	B–	A	U.E.S.
	31	B	13– 3	G	C	C	B–	C.P.S.
	32	B	11– 8	M	C	C+	C	U.E.S.
7	33	B	13–	M	C	B	C (geography)	Military school
	34	G	12– 7	M	C–	D	D	U.E.S.
	35	G	13–10	P	C	B	C–	U.E.S.
	36	B	14–	P	C	C	B– (geography)	P.S.
	37	G	14– 5	M	B–	A	B (geography)	C.P.S.
	38	B	13– 4	M	C	B	C+	U.E.S.
	39	B	11–11	M	C	B	B– (geography)	U.E.S.
	40	B	12–10	M	B–	C	C	U.E.S.
	41	B	12– 8	G	B–	C	B+	C.P.S.

TABLE II—*Continued*

Grade	Subject	Sex	Age	Grades for First Semester 1915–16		Early Training
			Yr.–Mo.	Reading Ability	Other Subjects	
H.S...	42	G	18–10	G	Average 93	C.P.S.
	43	B	18–10	G	Average 71+	C.P.S.
	44	G	17– 6	P	English 70; handwork 85	U.E.S.
	45	G	17– 7	G	Average 84+	Pr.S.
	46	G	14– 6	G	Average 84+	U.E.S.
	47	B	17– 1	M	English 70; science and handwork 80–85	C.P.S.
	48	G	15–11	G	Average 85+	U.E.S.
	49	B	16–	P	English F; handwork A	C.P.S.
	50	G	18– 5	G	Average 85+	C.P.S.
	51	B	16–10	M	Average 70	C.P.S.

reading work of those schools which was made during the years 1914–16. This survey revealed many differences in the reading ability of the pupils even in the same grades, with respect both to rate and to comprehension.

In order that this investigation might include all types of readers, certain pupils were chosen who had done very poorly in the tests used in the survey, others were selected who did exceedingly well, while others had an average record. The column headed "Reading Ability" is a general estimate based upon the results of the above-mentioned survey and the results of the present investigation. P means poor; M means medium; while G stands for good.

The data concerning the college subjects are limited, and they have not been listed in this table. Their grades in college are above the average.

CHAPTER II

TESTS FOR THE MEASUREMENT OF READING ABILITY

This chapter reports certain preliminary tests of both oral and silent reading carried out on all the persons investigated in this study. The results of these tests were made the basis for the experiments to be reported in later chapters.

At the outset the following passage was given to the pupils to read:

> Some of the men in the College of Education are very much interested in finding out how boys and girls learn to read. You have been selected, along with a large number of other children, to do some reading for me. I hope that you will do your very best and that you will follow my directions closely.

A like passage was shown to the adults. The rest of the material used was either printed or typewritten and presented to the readers on separate sheets. All tests were given to the pupils individually. Tests continued in most cases for a period of 30 minutes. Each test was timed by means of a stop-watch. The readers were seated and made to feel as comfortable and natural as possible.

ORAL-READING TESTS

The material for the oral tests consisted, first, in the standard passages in William S. Gray's reading scale (17). Since these passages are all descriptive and narrative prose passages, two new types of material were added—namely, poetry and an oratorical passage. The poetry was of four grades—very simple, easy, medium, and difficult. Owing to the difficulty of finding oratorical selections which required different degrees of reading ability, only one selection of this type was included in the tests.

As the subject read, four different kinds of mistakes were recorded—omissions, repetitions, insertions, and mispronunciations. One of the prose selections used is presented below, with the mistakes of a sixth-grade pupil marked. The symbols used to indicate the errors are as follows: "R" means repetition; "O"

means omission; "∧" means insertion; "M" means mispronunciation.

R

Once I went home from the city for a summer's rest. I took my gun for a stroll in the woods where I had shot many squirrels. I put my gun against a tree and M lay down upon the leaves. ∧ Soon I was fast asleep dreaming of a group of merry, laughing children running and playing about me on all sides.

The pupil was graded by the experimenter as poor, fair, good, or excellent, on the following points:[1] poise, pitch, articulation, pronunciation, emphasis, force, and interpretation. Poise refers to the freedom which the subject seemed to feel in the reading. For a number of superfluous movements and other signs of embarrassment a low grade was given; if the subject seemed perfectly at ease, a high grade was given. It is important to distinguish between lack of poise which is habitual with the subject and that produced by the conditions of the experiment. In most cases when the latter was present it disappeared before the tests were finished and was therefore absent when the grade was given.

Pitch was included in the list because some readers raise their voices in a marked degree when they read. Before the test began, the experimenter talked for a time with the subject so that the natural tone of voice might be observed, and a low grade was given if the voice was raised above the natural tone.

Articulation refers to the accuracy with which the difficult sounds are produced, while pronunciation refers to completeness and correctness of the enunciation of the word, such as the sounding of a final *s* or *ing*.

Emphasis refers to the stress which is put on certain words or phrases to make the meaning clear, while force refers to the amount of energy which is put into the reading as a whole.

[1] These points were selected from a large unpublished list which has been worked out by Professor J. Carleton Bell, of the Brooklyn Training School for Teachers.

Interpretation, as used here, refers to the ability of the reader to show by emphasis, inflection, pauses, etc., that the meaning of the author is appreciated.

After this preliminary discussion of the tests and the technique of giving them, we may now pass to a discussion of the results. Tables III and IV give typical results for two boys from the sixth

TABLE III

RECORD OF B. R. IN ORAL READING

Age, 13 years 2 months Grade 6 Sex, Boy

Selection	Repetitions	Insertions	Omissions	Mispronunciations	Total Errors	Time in Seconds and Minutes and Seconds	Rate: Words per Second
			PROSE				
1....	0	0	0	0	0	:15	3.2
2....	0	0	0	0	0	:19	2.6
3....	2	0	0	0	2	:22	2.7
4....	2	0	1	0	3	:25	2.4
5....	1	0	0	0	1	:29	2.1
6....	2	1	1	1	5	:29	2.1
7....	1	1	0	1	3	:30	1.8
8....	0	0	0	5	5	:40	1:3
9....	0	0	0	2	2	:50	1.0
10....	2	0	1	4	7	:40	1.1
11....	0	0	0	9	9	:50	0.9
12....	0	0	0	9	9	1:02	0.6
Total	10	2	3	31	46	6:51	.....
			POETRY				
2....	0	0	0	3	3	1:22	1.6
3....	2	0	0	7	9	1:20	1.3
4....	2	0	0	6	8	3:09	0.8
Total	4	0	0	16	20	5:51	.....
			ORATORY				
1....	2	0	0	8	10	2:38	1.0

Poise, F Pronunciation, P Force, F
Pitch, G Emphasis, F Interpretation, P
Articulation, F

grade whose records in Table II, p. 15, show that B. R. (No. 26) does his best work in the handicrafts, while W. E. (No. 31) does

his poorest work in the handicrafts. Most of the classifications used in Tables III and IV are clear, and it need only be said that the rate is given in the number of words read per second.

TABLE IV

RECORD OF W. E. IN ORAL READING

Age, 13 years 3 months Grade 6 Sex, Boy

Selection	Repetitions	Insertions	Omissions	Mispronunciations	Total Errors	Time in Seconds and Minutes and Seconds	Rate: Words per Second
			PROSE				
1....	0	0	0	0	0	:12	4.0
2....	0	0	0	0	0	:11	4.4
3....	0	0	0	0	0	:13	4.6
4....	0	0	0	0	0	:15	4.1
5....	1	0	0	0	1	:16	3.9
6....	0	0	0	0	0	:16	3.9
7....	0	0	0	1	1	:16	3.3
8....	0	0	0	0	0	:17	3.2
9....	1	0	0	2	3	:17	3.0
10....	2	0	0	3	5	:21	2.2
11....	0	0	0	1	1	:18	2.6
12....	1	0	0	1	2	:23	1.6
Total	5	0	0	8	13	3:15	.....
			POETRY				
2....	1	0	0	2	3	:40	3.3
3....	1	0	0	2	3	:41	2.5
4....	0	0	1	0	1	:56	2.6
Total	2	0	1	4	7	2:17	.....
			ORATORY				
1....	1	0	1	3	5	1:01	2.6

Poise, G Pronunciation, F Force, F
Pitch, P Emphasis, F Interpretation, P
Articulation, F

A comparison of the two records shows that W. E. reads about twice as fast as B. R. and with only half as many repetitions. By referring to the original material from which Table III was compiled, it is found that B. R. makes two kinds of repetitions: First,

he repeats several rather difficult words, such as "hesitated" and "scarcely." This probably means that he is not quite satisfied with his first pronunciation and so makes a second trial. Secondly, he repeats a considerable number of very easy words, such as "as" and "queen," even in so simple an expression as "spoke 'as' of old." This second type of repetition is much more difficult to explain, but it is probably due to lapses of attention—that is, the reader loses himself for the moment, and the repetition of a single word helps him to get under way again.

When the repetitions of W. E. are considered, it is found that he, too, repeats certain difficult words occurring in phrases, as "in such exigencies." This indicates that he comes to the difficult word, hesitates, takes a close look at it, then goes back and reads the phrase again. In some cases he pronounces the word correctly on second trial, and in others he makes no improvement. He also repeats such single difficult words as "profusion," but in no case does he repeat single simple words. The experiments to be reported in later chapters will throw further light on the difference between these two pupils.

A comparison of the records for omissions and insertions shows a slight advantage in favor of W. E. The omissions may either be due to lapses of attention on the part of B. R. or it may be that his eye-movements are of such a nature that words are missed. Such errors may be due to the fact that the attention moves so much faster than the voice that words are forgotten. In some cases the insertions are such as to make good sense, while in other cases the expression with the inserted word means little or nothing. The explanation of the latter type of error may lie in the fact that the phrase meant little in the first place, and the inserted word therefore did not change it for the reader.

The greatest contrast between the two subjects is found in the number of mispronunciations. This indicates clearly that the slow reader does not have the control of language which the rapid reader has. If the records for poetry and oratory are compared, it is found that the advantage rests with W. E. in all points except that of omissions.

TABLE V

Record of All Subjects in the Oral Reading of Prose

Grade	Subject	No. of Selections	Repetitions	Insertions	Omissions	Mispronunciations	Total Errors	Range in Rate	Minimum-Rate Group
	1	7	33	3	4	19	59	2.5–0.8	1
	2	8	5	1	4	10	20	3.3–1.5	2
	3	9	14	0	2	7	23	4.8–1.3	2
	4	9	8	3	4	13	28	3.4–1.2	2
3	5	5	6	9	5	14	34	2.3–1.1	2
	6	7	15	3	3	7	28	2.7–1.3	2
	7	7	7	4	8	1	20	2.9–1.8	2
	8	6	25	9	10	13	57	1.7–0.8	1
	9	6	6	6	4	16	32	2.7–1.3	2
	10	12	4	2	9	26	41	3.8–1.2	2
	11	12	6	2	5	18	31	4.3–1.4	2
	12	10	8	1	5	32	46	3.7–0.8	1
4	13	11	8	0	1	29	38	2.8–0.6	1
	14	10	6	3	5	24	38	2.9–0.8	1
	15	8	5	1	3	27	36	2.6–0.7	1
	16	11	7	5	9	29	50	3.2–1.0	1
	17	10	12	5	7	22	46	2.7–0.8	1
	18	12	7	0	4	15	26	3.8–1.0	1
	19	11	8	2	3	30	43	3.1–0.6	1
	20	11	6	2	5	28	41	3.3–1.3	2
5	21	12	8	6	4	23	41	4.8–1.0	1
	22	11	5	1	1	30	37	3.5–1.2	2
	23	12	3	5	6	29	43	4.3–1.0	1
	24	12	7	0	4	14	25	3.8–0.9	1
	25	11	7	2	3	33	45	3.2–0.7	1
	26	12	10	2	3	31	46	3.2–0.6	1
	27	12	11	5	4	39	59	3.7–1.3	2
	28	12	1	0	2	19	22	3.8–0.9	1
6	29	11	7	4	6	19	36	3.7–1.3	2
	30	12	5	0	2	12	19	3.7–1.7	2
	31	12	5	0	0	8	13	4.6–1.6	2
	32	12	4	1	10	24	39	3.4–1.1	2

	33	12	6	2	5	31	44	3.9–1.3	2
	34	12	4	4	3	17	28	3.5–1.0	1
	35	12	5	1	3	11	20	3.7–0.8	1
	36	12	10	1	1	20	32	3.7–0.9	1
7	37	12	8	1	5	20	34	4.6–1.0	1
	38	12	9	4	7	24	44	3.6–0.9	1
	39	12	7	2	3	20	32	4.3–1.3	2
	40	12	4	1	2	7	14	4.1–1.7	2
	41	12	8	2	6	11	27	4.1–1.6	2
	42	12	2	0	0	1	3	5.2–2.4	3
	43	12	7	2	0	6	15	4.1–2.2	3
	44	12	6	1	5	17	29	3.7–0.9	1
	45	12	7	1	0	10	18	4.8–1.8	2
H.S.	46	12	3	0	1	2	6	5.4–2.2	3
	47	12	2	3	4	8	17	4.3–1.9	2
	48	12	3	0	1	6	10	4.6–1.7	2
	49	11	9	4	12	35	60	3.7–1.0	1
	50	12	2	1	0	5	8	5.3–2.1	3
	51	12	7	2	0	5	14	4.4–1.6	2
	52	12	9	4	9	7	29	5.4–1.9	2
	53	12	3	5	0	7	15	4.8–2.2	3
	54	12	3	0	1	10	14	4.5–1.8	2
C.	55	12	7	0	0	5	12	4.0–2.1	3
	56	12	3	3	6	8	20	4.8–1.7	2
	57	12	3	1	0	4	8	4.9–2.1	3
	58	12	2	1	1	3	7	4.1–1.9	2
	59	12	9	5	2	13	29	5.0–1.3	2

The two readers show much the same characteristics whether reading prose or poetry. Indeed, as will be seen from the long table including many subjects, the chief difference which results from a variation of the type of reading matter is a difference in rate.

It is interesting to compare the grades in the elements of oral reading listed at the bottom of the two tables. In most instances these grades are the same for both subjects. It is also true that most of the grades are either F or P. This can only mean that the school fails to emphasize the particular virtues called for or else that the training of the school has been futile in the case of these subjects.

Table V is a general table made up from individual records like those shown in Tables III and IV and presents only the results from the prose passages in William S. Gray's scale. The double column next to the last at the extreme right shows the highest and lowest rates attained on any one selection. The different subjects are grouped in grades, as indicated by the horizontal lines, and are numbered according to their alphabetical order within each grade. Some of the subjects did not read all the selections. The number read by each subject is indicated in the third vertical column.

In order to facilitate a comparison of rate and accuracy, all the persons reported in Table V are regrouped according to the minimum rates which they exhibited in reading any passage. The first group contains the persons who have a minimum rate of 1 word per second or less. The second group contains all persons who have a minimum rate between 1.1 and 2 words per second; the third, those having a minimum between 2.1 and 3 words per second. The first column at the left in Table V A indicates these groups. The third column gives the number of subjects in each group; the fourth shows the school grades which have representatives in the various groups; the fifth shows the range in the maximum rate attained by individuals in each group, and the last shows the range in total errors made by each group.

A consideration of this table leads to the following comments: The maximum rates follow in general the minimum rates, Group 2 being much faster than Group 1, and Group 3 being at a higher level than Group 2, although the upper limits of the last two

groups are the same. The table shows also that the greatest number of errors is made by Group 1. The most striking difference is the very marked reduction of errors in Group 3 as compared with Group 2.

TABLE V A

SUMMARY OF TABLE V ON THE BASIS OF RANGE IN MINIMUM RATE

Minimum-Rate Groups	Range in Minimum Rate	No. in Group	Grades	Range in Maximum Rate	Range in Total Errors
1.....	0.6–1.0	23	3, 4, 5, 6, 7, H.S.	1.7–4.8	20–60
2.....	1.1–2.0	29	3, 4, 5, 6, 7, H.S., C.	2.3–5.4	7–59
3.....	2.1–3.0	7	H.S., C.	4.0–5.4	3–15

A consideration of the grades represented in the different groups shows that Group 1 contains no college students, Group 2 has one or more individuals from each of the grades, while Group 3 includes only persons from the high school and college.

Another interesting point is brought out in the large range of errors in Group 2. Such a fact indicates that those who read at a medium rate are not at all settled in their reading habits, for some of them read poorly and others read with a considerable degree of efficiency. The practical significance of this fact is that the type of reading indicated in Group 2 is probably characteristic of the transition period in the child's reading, and during this period training should be most painstaking and intelligent.

To return to Table V and a more detailed consideration of the errors made, it will be noted that in forty-eight cases the largest number of errors is made in the pronouncing of words. The exceptions are found in the third grade and in the best readers of the high school or college, where repetitions are more numerous than mispronunciations. In the third grade this means that the child has better control of his visual vocabulary than he has of the other phases of reading. Among the high-school and college students where these exceptions are found, the number of errors of each type is relatively small. This probably means that training has reached the point where the subject is equally proficient in the different aspects of the reading process.

The results for omissions, repetitions, insertions, mispronunciations, and total errors are shown in the form of distribution curves

in Diagrams 1, 2, 3, 4, and 5. Each rectangle represents one subject, and the height of the rectangles represents the number of errors. An examination of these diagrams reveals very clearly the fact that, except in the matter of errors in pronunciation, one

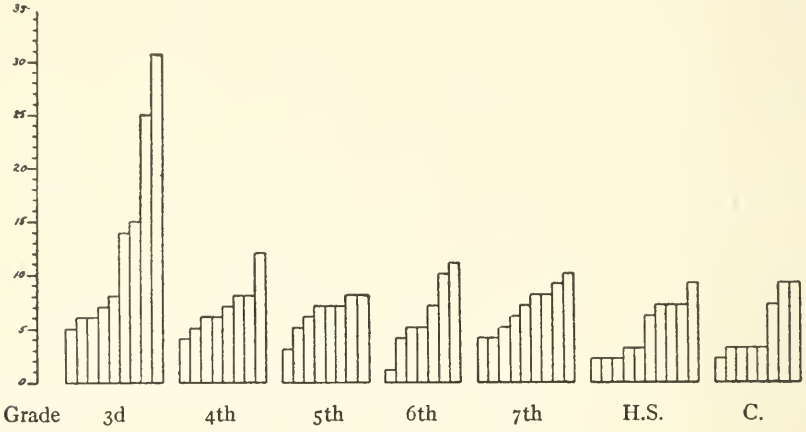


DIAGRAM 1.—Distribution of repetitions

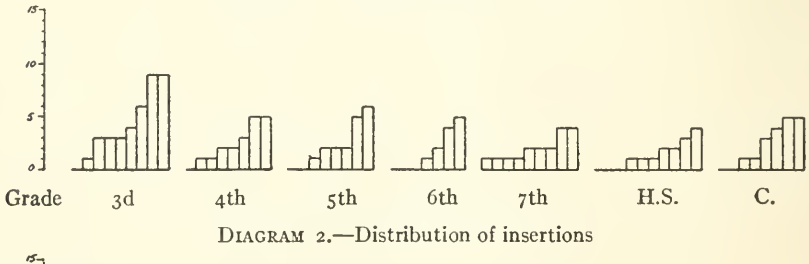


DIAGRAM 2.—Distribution of insertions

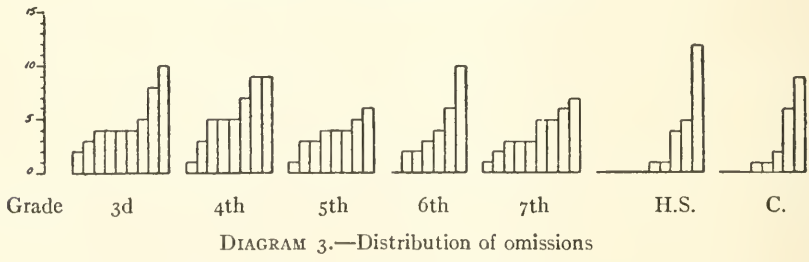


DIAGRAM 3.—Distribution of omissions

school grade is not very different from any other. To illustrate, the number of insertions made by the fifth grade does not differ materially from the number of insertions made by the fourth grade. Evidently training is effective only in a very

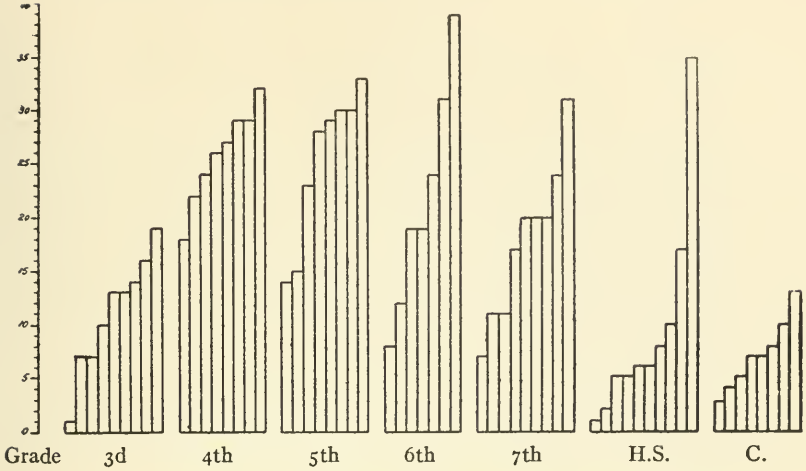


DIAGRAM 4.—Distribution of mispronunciations

DIAGRAM 5.—Distribution of total errors

TABLE VI

RECORD OF ALL SUBJECTS IN THE ORAL READING OF POETRY

Grade	Subject	No. of Selections	Repetitions	Insertions	Omissions	Mispronunciations	Total Errors	Range in Rate	Minimum-Rate Group
	1	2	21	4	3	9	37	1.0	1
	2	2	1	4	5	4	14	2.6–2.4	3
	3	2	1	1	0	5	7	3.2–2.5	3
	4	3	4	1	1	5	11	2.5–1.7	2
3	5	1	2	4	4	7	17	1.2	2
	6	2	6	4	4	8	22	2.2–1.7	2
	7	2	2	3	2	1	8	2.1–1.9	2
	8	1	2	3	3	4	12	1.3	2
	9	2	4	2	4	18	28	1.8–1.4	2
	10	3	1	0	5	12	18	2.9–2.1	3
	11	3	3	2	1	8	14	3.0–2.6	3
	12	3	5	1	3	31	40	1.7–1.4	2
4	13	3	6	0	0	8	14	2.2–1.2	2
	14	2	4	1	2	19	26	1.6–1.3	2
	15	2	2	1	1	32	36	1.1–1.0	1
	16	3	13	1	1	10	25	1.9–1.4	2
	17	3	10	2	4	15	31	1.7–1.3	2
	18	3	2	0	1	15	18	2.0–1.7	2
	19	3	10	0	0	16	26	2.2–1.2	2
	20	3	3	1	6	23	33	2.2–1.9	2
5	21	3	1	2	6	9	18	2.6–1.9	2
	22	3	2	0	0	11	13	2.8–2.2	3
	23	3	6	2	2	11	21	2.5–2.1	3
	24	3	3	0	0	5	8	3.0–2.0	2
	25	3	3	1	2	12	18	2.0–1.2	2

6	26	3	4	0	0	16	20	1.6–0.8	1
	27	3	7	2	5	17	31	3.0–2.3	3
	28	2	0	0	0	6	6	3.3–2.3	3
	29	2	2	0	0	10	12	2.4–2.1	3
	30	3	2	0	3	0	5	3.0–2.4	3
	31	3	2	0	1	4	7	3.3–2.5	3
	32	3	5	0	0	6	11	2.6–2.1	3
7	33	3	5	4	4	13	26	3.2–1.8	2
	34	3	3	1	0	11	15	2.1–1.8	2
	35	3	2	1	0	5	8	2.3–1.7	2
	36	3	6	0	2	5	13	2.5–2.0	2
	37	3	4	0	0	16	20	3.0–2.6	3
	38	3	6	4	3	17	30	2.6–1.8	2
	39	3	3	2	2	1	8	3.4–2.3	3
	40	3	1	0	0	2	3	3.4–2.8	3
	41	3	5	3	2	6	16	3.3–2.2	3
H.S.	42	3	0	0	0	2	2	4.1–3.0	3
	43	3	3	0	0	1	4	3.0–2.7	3
	44	3	6	2	2	12	22	2.6–2.0	2
	45	3	3	0	0	6	9	4.1–2.9	3
	46	3	1	0	0	2	3	4.4–3.3	4
	47	3	0	0	2	3	5	3.4–2.6	3
	48	3	2	0	1	2	5	3.4–2.7	3
	49	3	2	4	0	36	42	2.0–1.3	2
	50	3	1	0	0	6	7	4.4–3.1	4
	51	3	5	2	1	1	9	3.1–2.7	3
C	52	3	7	0	0	11	18	4.3–2.9	3
	53	3	2	0	0	4	6	4.0–2.9	3
	54	3	1	0	0	1	2	4.0–3.2	4
	55	3	5	0	0	2	7	3.2–2.5	3
	56	3	1	0	3	6	10	3.8–3.1	4
	57	3	1	0	0	0	1	4.0–3.1	4
	58	3	0	0	0	0	0	3.4–2.6	3
	59	3	5	0	2	8	15	3.4–2.7	3

limited degree in preventing omissions, repetitions, and insertions, but is effective in preventing or correcting mispronunciations and hence also total errors. The explanation is either that the items which show little improvement get no attention in school or else that they are not so easily open to effects of training. It would be exceedingly interesting to set up experiments for the purpose of discovering whether repetitions, omissions, and insertions are more difficult to eliminate than mispronunciations. Until such experiments are tried, it will be difficult to decide whether the teacher should attempt to correct all classes of errors by instruction or should wait for maturity to do the work.

Table VI contains the same type of result for poetry that is given in Table V for prose. In connection with this table the following comments may be made:

1. The predominating error is mispronunciation, as it was in prose.

2. The predominating error of subjects Nos. 1, 51, and 55 is repetition, as was true in prose, but subjects Nos. 3, 6, 8, and 52 change their predominating error from repetitions in prose to mispronunciations in poetry.

3. The predominating error for subjects Nos. 1, 43, 51, and 57 is repetition, while in the case of Nos. 48 and 54 repetitions are equal in number to mispronunciations. In the case of Nos. 2, 7, and 30 omissions, insertions, and omissions, respectively, are made more often than any other type.

TABLE VI A

SUMMARY OF TABLE VI ON THE BASIS OF RANGE IN MINIMUM RATE

Minimum-Rate Groups	Range in Minimum Rate	No. in Group	Grades	Range in Maximum Rate	Range in Total Errors
1.....	0.8–1.0	3	3, 4, 6	1.0–1.6	20–37
2.....	1.1–2.0	24	3, 4, 5, 7, H.S.	1.6–3.2	8–42
3.....	2.1–3.0	27	3, 4, 5, 6, 7, H.S., C.	2.4–4.3	0–42
4.....	3.1–4.0	5	H.S., C.	3.8–4.4	1–10

Table VI is summarized in Table VI A. The only point which needs to be emphasized here is that the two medium-rate groups, 2 and 3, have very large ranges in the number of errors made.

Table VII and VII A follow with the same type of results for oratory. No new point which needs to be emphasized comes out

TABLE VII

RECORD OF ALL SUBJECTS IN ORAL READING OF ORATORY

Grade	Subject	Repetitions	Insertions	Omissions	Mispronunciations	Total Errors	Rate	Group
	10	0	0	2	10	12	2.0	2
	11	6	0	2	6	14	2.5	3
	12	.....	.....	.....	.....	.....	.....	.....
4.....	13	0	0	0	15	15	0.9	1
	14	.....	.....	.....	.....	.....	.....	.....
	15	.....	.....	.....	.....	.....	.....	.....
	16	1	1	5	19	26	1.3	2
	17	4	0	0	19	23	1.0	1
	18	0	0	0	8	8	1.5	2
	19	2	0	0	14	16	0.6	1
	20	4	0	2	18	24	1.6	2
	21	1	1	3	6	11	1.6	2
5.....	22	0	0	0	12	12	1.8	2
	23	0	0	3	12	15	2.0	2
	24	1	1	1	2	5	1.9	2
	25	1	0	0	18	19	0.9	1
	26	2	0	0	8	10	1.0	1
	27	3	0	2	5	10	1.9	2
	28	1	0	1	7	9	2.0	2
6.....	29	1	0	0	7	8	1.9	2
	30	2	0	2	4	8	2.4	3
	31	1	0	1	3	5	2.6	3
	32	0	0	0	9	9	1.9	2
	33	3	1	2	8	14	2.0	2
	34	0	0	0	4	4	1.6	2
	35	1	0	0	4	5	1.7	2
	36	0	0	0	5	5	1.9	2
7.....	37	0	0	1	8	9	2.0	2
	38	1	1	9	10	21	1.6	2
	39	2	1	1	8	12	2.2	3
	40	1	1	0	5	7	2.5	3
	41	2	0	3	5	10	2.3	3
	42	3	0	0	1	4	3.4	4
	43	4	0	1	3	8	2.7	3
	44	2	0	0	8	10	1.6	2
	45	1	0	0	3	4	2.8	3
H.S....	46	1	1	0	1	3	3.2	4
	47	0	0	1	1	2	2.6	3
	48	0	0	0	3	3	2.4	3
	49	0	1	0	16	17	0.9	1
	50	3	0	0	0	3	3.2	4
	51	1	0	1	2	4	2.7	3
	52	1	0	0	5	6	3.0	3
	53	1	0	0	2	3	2.9	3
	54	0	0	0	2	2	3.1	4
C.....	55	4	0	0	1	5	2.4	3
	56	3	1	0	2	6	3.1	4
	57	0	1	0	3	4	2.7	3
	58	1	1	0	5	7	3.0	3
	59	1	0	0	6	7	2.6	3

in these tables. A comparison of the different rates for the reading of different types of material will be made at the end of the chapter.

TABLE VII A

SUMMARY OF TABLE VII ON THE BASIS OF RANGE IN MINIMUM RATE

Minimum-Rate Groups	Range in Minimum Rate	Number in Group	Grades	Range in Total Errors
1	0.6–1.0	6	4, 5, 6, H.S.	10–23
2	1.1–2.0	19	4, 5, 6, 7, H.S.	4–26
3	2.1–3.0	17	4, 6, 7, H.S., C.	2–14
4	3.1–4.0	5	H.S., C.	2– 6

Table VIII shows the grades given on the various phases of oral reading. In connection with this table the following points may be noted:

1. The highest grade, E, is not used.

2. Three pupils, Nos. 13, 30, and 40, receive either G or G+ for each of the points in the list.

3. Nine pupils are not graded above F+ in any item. Among these is No. 57, who makes only eight errors. On the other hand, the pupil who makes the most errors, No. 49, is not graded above P.

4. The scores are somewhat higher in the upper grades than in the lower grades.

This table gives in detail the justification for the remark made in connection with the records of B. R. and W. E. that the practices of the school with regard to instruction in the different phases of reading need careful consideration and experimental study.

SILENT-READING TESTS

The silent-reading tests were carried on along several lines. The passages for the different lines of tests were selected from the same readers and were chosen to be as nearly comparable as possible. The method of testing efficiency, however, was varied. In the first case the reader was asked to answer set questions. In the second, he reproduced freely what he had read. In the third case he was asked to outline the main points. Fourthly, he was asked to read as fast as possible.

SILENT READING FOR THE PURPOSE OF ANSWERING QUESTIONS

The first method used in testing silent reading was that of requiring the subject to read certain selected passages and to write the answers to questions based on the selection read. Ten prose selections were used, and five questions were asked on each. The tenth selection was read by adults only. In all other cases the pupils read as many of the selections as they were able to read. Selections 1–9 were taken from the "Riverside Series" of readers, which included a primer and a reader for each of the eight grades and were so selected that they represented increasing difficulties.

In addition to the prose selections four short poems were read. Third-grade pupils did not read the last two selections of poetry, while all the other subjects omitted the first selection. Five questions were asked on each poem.

The answers were scored for full credit, half-credit, or no credit. One of the prose selections used, together with the questions, follows:

SELECTION 3

On the steep hillside grew a tall ash tree. Right on the bank of the rushing brook it grew. Its branches spread far out across the little stream. Its leaves looked down into the flashing water. There, when the sun shone brightly, they saw leaves looking up at them. They called these "water leaves."

1. Where did the ash tree grow?
2. How far did its branches spread?
3. Where did the leaves look?
4. What did they see when the sun shone?
5. What did they call these leaves?

Tables IX and X give the records of B. R. and W. E., the same pupils whose reports are given in Tables III and IV. An examination of the tables shows that:

1. B. R. reads silently about one-third as fast as W. E.

2. B. R. attempts seven-tenths as many questions as W. E.

3. B. R. answers correctly 83 per cent of the questions attempted, while W. E. answers correctly 72 per cent of those attempted.

4. B. R. falls below W. E. in answering questions by about one-tenth.

TABLE VIII

GRADES OF ALL SUBJECTS ON THE VARIOUS PHASES OF ORAL READING

GRADE	SUBJECT	ELEMENTS OF ORAL READING							TOTAL ERRORS
		Poise	Pitch	Articulation	Pronunciation	Emphasis	Force	Interpretation	
3	1	F	F	F	P	F	P	P	59
	2	F	G	P	G	P	P	F	20
	3	G	G	P	G	F	F	F	23
	4	F	F	G	G	G	G	G	28
	5	F	P	F	P	F	P	P	34
	6	G	G	P	G	F	F	F	28
	7	G	F	P	G	G	F	G	20
	8	P	G	F	P	F	P	P	57
	9	F	P	P	F	P	P	F	32
4	10	G	G	P	P	G−	F	P	41
	11	F	F	F	P	F	G−	P	31
	12	F	G	F	P	P	P	P	46
	13	G	G	G	G	G	G	G	38
	14	G	F	P	F	P	P	P	38
	15	G	G	F	F	P	P	P	36
	16	G	P	G	F	P	P	F	50
	17	G	G	F	P	P	P	P	46
5	18	F	F	F	F	P	F	P	26
	19	F	F	F	F	F	F	P	43
	20	F+	G	F	F−	P	P	P	41
	21	G−	F+	F	F	F−	F	P	41
	22	F	G−	P	F	F+	G−	P	37
	23	F	F	G	G	F	F	P	43
	24	G	G	G	G	G	G	F	25
	25	F	G	F	F	F	P	P	45

6	26	F	G	F	P	F	F	P	46
	27	F	F+	F+	F	F	F	P	59
	28	G	G	P	P	G	G	V.P.	22
	29	G	G	F	F	F	F	P	36
	30	G	G+	G+	G	G+	G	G+	19
	31	G	P	F	F	F	F	P	13
	32	G	G	F	F	G	G	P	39
7	33	G	G	F	F	F	F	G	44
	34	G	G+	F	G−	F	F	P	28
	35	G−	G−	G	G−	P	P	P	20
	36	F	G	F	F	P	P	P	32
	37	G	G+	F+	F	F	F	P+	34
	38	G	G	F	P	F	F	P	44
	39	G	F	P	G	F	F	F	32
	40	G+	G	G+	G+	G	G	G	14
	41	G	F	G	G+	G	G	G	27
H.S.	42	G+	F	G	G	F	F	G+	3
	43	G	G+	F	G−	F	F	F−	15
	44	F	F	F	F	F	F	F	29
	45	F	G	G−	G	G	G−	F+	18
	46	G	G+	G	G+	G+	F	F−	6
	47	G	P	F	F	G	F	G	17
	48	F	G+	G	G−	G	F−	F−	10
	49	P	P	P	P	P	P	P	60
	50	G+	G+	G	G+	G	F	G	8
	51	G+	G+	F	F	G	F	G	14
C	52	G	G	P	P	P	P	P	29
	53	G	G	F	G	G	G	G	15
	54	G	G	G	F	F	F	G	14
	55	G	G	G	G	F	F	F	12
	56	G	G−	F	F	F	F	F	20
	57	F	F	F	F	F	F	F	8
	58	G	G	G	F	G	G	G	7
	59	G	G	F	F	F	F	F	29

5. B. R. requires a little more than 36 seconds in which to answer each question attempted, while W. E. requires 28 seconds.

TABLE IX

RECORD OF B. R. IN SILENT READING OF PROSE FOR ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Time for Writing
1.....	:14	2.9	5	4.5	1:15
2.....	:22	2.1	5	4.5	1:23
3.....	:33	1.6	4	3.5	2:03
4.....	:37	1.9	5	4.5	3:30
5.....	:52	1.3	3	3.0	1:53
6.....	1:04	1.0	4	3.0	1:53
7.....	:47	1.3	2	1.5	1:31
8.....	1:12	0.8	3	1.5	2:48
9.....	1:46	0.8	3	2.5	2:19
Total....	7:27	.....	34	28.5	18:35

TABLE X

RECORD OF W. E. IN SILENT READING OF PROSE FOR ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Time for Writing
1.....	:08	5.1	5	3.0	1:52
2.....	:12	3.9	5	3.0	2:12
3.....	:16	3.4	5	5.0	1:42
4.....	:17	4.1	5	3.5	3:20
5.....	:14	5.6	5	4.0	3:32
6.....	:14	4.6	5	2.5	4:05
7.....	:21	3.0	5	4.0	1:39
8.....	:12	5.0	5	4.5	2:25
9.....	:35	2.5	5	3.0	2:15
Total....	2:29	.....	45	32.5	23:02

It is evident that B. R. is not as efficient as W. E. in silent reading. The greater difference appears in speed rather than in the number of questions answered. By comparing Tables III and IX it will be seen that B. R.'s rate is slightly higher in oral than in silent reading. It may be that, in his haste to reduce some of the very apparent slowness and jerkiness in his reading, he runs over many words without giving them the proper attention and therefore makes additional errors in oral reading.

Table XI presents totals for all subjects. The percentage of questions correct is based upon the total number of questions asked on the selections read, or five questions to each selection.

TABLE XI

RECORD OF ALL SUBJECTS IN SILENT READING OF PROSE FOR ANSWERING QUESTIONS

Grade	Subject	No. of Selections	Range in Rate	Minimum-Rate Group	Questions Attempted	Writing Time	Percentage of Questions Correct
3	1	7	3.1–1.3	2	32	7:23	45.7
	2	7	4.5–2.5	3	20	5:31	40.0
	3	6	3.6–2.1	3	23	6:13	41.7
	4	7	4.1–2.2	3	29	10:22	61.4
	5	5	1.9–1.5	2	20	4:44	64.0
	6	6	3.3–1.9	2	17	7:04	55.0
	7	6	5.8–2.5	3	30	7:12	75.0
	8	6	1.9–0.8	1	28	7:37	60.0
	9	4	2.5–1.9	2	19	5:37	55.0
4	10	9	3.1–1.7	2	44	25:17	56.6
	11	9	2.7–1.6	2	45	19:09	67.8
	12	9	3.0–1.6	2	45	18:57	62.2
	13	7	2.4–1.3	2	26	15:09	64.3
	14	8	3.4–1.5	2	34	16:05	51.2
	15	8	2.2–1.0	1	23	13:39	38.7
	16	9	2.9–0.9	1	45	36:05	63.3
	17	9	2.0–1.2	2	44	40:28	42.2
5	18	9	3.1–1.7	2	45	13:45	58.9
	19	9	2.9–1.2	2	29	16:49	56.7
	20	9	3.1–1.2	2	42	19:53	55.5
	21	9	3.5–1.5	2	35	30:39	75.5
	22	9	2.3–0.8	1	39	40:51	62.2
	23	9	3.8–1.4	2	39	22:53	53.3
	24	9	4.1–2.1	3	41	21:50	74.4
	25	9	3.0–1.2	2	45	35:00	52.2
6	26	9	2.9–0.8	1	34	18:35	63.3
	27	9	5.3–1.8	2	45	25:27	66.6
	28	9	3.7–1.3	2	37	15:30	57.8
	29	9	4.1–2.1	3	37	14:53	52.2
	30	9	6.0–4.3	5	43	16:26	72.2
	31	9	5.6–2.5	3	45	23:02	72.2
	32	9	4.6–1.6	2	44	17:41	76.6
7	33	9	4.1–2.5	3	44	13:21	72.2
	34	9	3.4–1.3	2	43	14:08	65.5
	35	9	3.0–1.9	2	44	18:19	46.6
	36	9	3.4–1.9	2	44	17:12	74.4
	37	9	4.1–1.6	2	40	17:04	74.4
	38	9	5.9–2.0	2	39	11:44	72.2
	39	9	5.9–2.8	3	33	7:48	62.2
	40	9	4.6–2.4	3	38	14:57	71.1
	41	9	3.5–2.1	3	43	18:20	76.6
H.S.	42	10	4.9–2.5	3	45	9:23	81.0
	43	10	6.5–3.5	4	48	9:37	63.0
	44	10	4.7–2.0	2	49	16:08	59.0
	45	10	3.9–2.6	3	48	12:50	75.0
	46	10	4.6–1.9	2	47	14:10	86.0
	47	10	6.5–3.3	4	42	15:32	61.0
	48	10	4.1–1.8	2	49	16:05	86.0
	49	5	3.1–1.4	2	13	5:03	48.0
	50	10	5.1–2.1	3	47	12:23	67.0
	51	10	4.6–2.1	3	46	15:48	63.0

TABLE XI—*Continued*

Grade	Subject	No. of Selections	Range in Rate	Minimum-Rate Group	Questions Attempted	Writing Time	Percentage of Questions Correct
C.....	52	10	8.2–3.8	4	37	5:23	42.0
	53	10	8.2–3.1	4	47	14:38	82.0
	54	10	8.2–3.4	4	43	9:05	53.0
	55	10	4.1–2.4	3	39	12:33	57.0
	56	10	6.8–3.3	4	31	8:17	23.0
	57	10	10.0–3.6	4	28	5:14	40.0
	58	10	6.8–3.1	4	49	9:09	63.0
	59	10	6.0–2.8	3	44	14:49	53.0

TABLE XI A

SUMMARY OF TABLE XI ON THE BASIS OF RANGE IN MINIMUM RATE

Group	Range in Minimum Rate	No. in Group	Grades	Range in Maximum Rate	Range in No. of Questions Attempted	Range in Percentage of Questions Correct	Range in Writing Time
1....	0.8–1.0	5	3, 4, 5, 6	1.9– 2.9	28–45	60.0–63.3	7:37–40:51
2....	1.1–2.0	28	3, 4, 5, 6, 7, H.S.	1.9– 5.9	13–49	42.2–86.0	4:44–40:28
3....	2.1–3.0	17	3, 5, 6, 7, H.S., C.	3.6– 6.0	20–48	40.0–81.0	5:31–23:02
4....	3.1–4.0	8	H.S., C.	6.5–10.0	28–49	23.0–82.0	5:14–15:32
5....	4.1–5.0	1	6	6.0	43	72.2	16:26

Table XI A, which rearranges the subjects into groups according to minimum rates, reveals the following points:

1. The minimum rates vary from 0.8 to 5.0 words per second, while the maximum rates vary from 1.9 to 10.0 words per second.

2. The minimum rates for Groups 4 and 5 are greater than the maximum rates for Group 1.

3. The upper limit of the number of questions attempted varies only from forty-three to forty-nine.

4. The range in the number of questions attempted by Groups 1 and 4 differs only by four.

5. The widest range in the number of questions attempted is shown in Group 2.

6. The upper limit of the percentage of questions correct differs only five points in Groups 2, 3, and 4.

7. The wide range in the percentage of questions correct in Group 4 evidently means that some persons in the group read too fast to be efficient. The very slight difference in the efficiency of

Groups 2 and 3 indicates clearly that reading to answer questions requires a certain technique which the more rapid readers in Group 3 have not developed in any greater degree than those in Group 2, who do not read so rapidly.

8. There is a decided decrease in the upper limits of the time required for writing if Groups 2, 3, and 4 are considered. If the lower limits of writing time are considered, the difference is not very great. These variations in writing time are due to several causes. The time is in some cases short because there is little written. But the reduction in amount has very different meanings in different cases. In the case of subject No. 5 little is written because little is retained, while in the case of No. 42 the material written is very much condensed. The longer times are sometimes due to a slow rate of writing, sometimes to answers which are longer than necessary, sometimes, as in the cases of No. 22 and No. 17, to the fact that time is wasted.

TABLE XII

RECORD OF B. R. IN SILENT READING OF POETRY FOR ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Time for Writing
2.....	1:30	1.2	5	4.5	2:47
3.....	1:24	1.4	2	2.0	2:12
4.....	2:25	1.0	2	1.0	2:54
Total....	5:19	.....	9	7.5	7:53

TABLE XIII

RECORD OF W. E. IN SILENT READING OF POETRY FOR ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Time for Writing
2.....	:33	3.3	5	4.0	1:39
3.....	:35	3.4	5	3.0	2:39
4.....	1:18	1.8	5	1.0	1:45
Total....	2:26	.....	15	8.0	6:03

Tables XII and XIII give the records in poetry for B. R. and W. E. An examination of these tables shows that:

1. B. R. reads about one-half as fast as W. E.

2. The number of questions attempted by each is quite different, while the number answered correctly is almost the same. This emphasizes again the fact that B. R.'s chief difficulty in silent reading is that he is slow.

By comparing Tables XII and IX and Tables XIII and X we see that both subjects are low in rates of reading poetry and somewhat lower in their percentages of questions answered correctly. This is probably due to the fact that pupils who have little training in reading poetry find it in general more difficult to answer questions on poetry than on prose.

Table XIV gives the results for all subjects in the silent reading of poetry, and Table XIV A redistributes the subjects according to speed.

Attention may be called in Table XIV A to the fact that the more rapid readers of Groups 4 and 5 do not attempt as many questions nor answer as great a percentage of them as Groups 2 and 3. This is an indication that Groups 4 and 5 read too rapidly for efficiency.

The results for poetry and prose are contrasted in Tables XXVII and XXVIII near the close of the present chapter.

SILENT READING FOR THE PURPOSE OF REPRODUCTION

The second method used for testing silent reading was that of having the subjects read passages and reproduce the material read. In this test there were ten prose selections taken from the "Riverside Series" of readers, selection 1 being first-grade material; selection 2, second-grade; and so on to the tenth selection, which was difficult material. Each subject read and reproduced the three selections which represented his own grade and the second grade above and the second grade below that grade. That is, fifth-grade pupils read selections 3, 5, and 7. An exception was made in the case of the third grade, which read selections 2, 3, and 5.

In order to score the results in this test, each selection was divided into units, and the reader was given credit for each of the units he reproduced. These units were not intended to represent

TABLE XIV

RECORD OF ALL SUBJECTS IN SILENT READING OF POETRY FOR ANSWERING QUESTIONS

Grade	Subject	No. of Selections	Range in Rate	Minimum-Rate Group	Questions Attempted	Writing Time	Percentage of Questions Correct
	1	2	1.9–1.7	2	9	1:44	55.0
	2	2	3.6–2.9	3	7	1:30	60.0
	3	2	3.7–3.4	4	10	1:56	80.0
	4	2	3.1–2.8	3	9	2:38	90.0
3.....	5	2	1.6–1.4	2	9	2:27	50.0
	6	2	2.3–2.2	3	8	2:59	60.0
	7	2	3.3–2.5	3	10	2:02	100.0
	8	2	1.2–0.9	1	10	2:33	65.0
	9	2	2.1–1.7	2	8	2:47	60.0
	10	3	2.4–1.7	2	15	6:00	46.6
	11	3	3.1–2.3	3	15	5:41	60.0
	12	3	2.6–2.1	3	15	2:13	46.6
4.....	13	3	1.8–1.6	2	9	3:48	56.6
	14	2	2.1–1.9	2	6	3:22	50.0
	15	2	1.5–1.4	2	3	1:28	20.0
	16	3	1.6–1.2	2	14	9:13	46.6
	17	3	1.6–1.4	2	13	12:41	40.0
	18	3	2.1–1.7	2	15	3:12	40.0
	19	3	2.3–1.9	2	12	9:03	40.0
	20	3	2.7–1.6	2	12	5:54	23.3
5.....	21	3	3.1–2.8	3	8	6:27	23.3
	22	3	2.4–1.3	2	6	5:14	13.3
	23	3	3.5–2.3	3	10	5:54	33.3
	24	3	4.4–2.8	3	14	5:40	53.3
	25	3	1.9–1.5	2	15	10:51	43.3
	26	3	1.4–1.0	1	9	6:53	50.0
	27	3	3.3–2.7	3	15	6:50	53.3
	28	3	2.5–1.8	2	8	4:50	13.3
6.....	29	3	2.4–1.7	2	8	4:58	40.0
	30	3	4.8–3.4	4	11	3:20	33.3
	31	3	3.4–1.8	2	15	6:03	53.3
	32	3	3.1–2.1	3	15	7:05	60:0
	33	3	3.3–2.4	3	15	3:59	46.6
	34	3	2.7–2.0	2	12	4:04	26.6
	35	3	2.6–1.8	2	9	3:14	33.3
	36	3	3.0–2.2	3	10	4:18	40.0
7.....	37	3	2.8–1.9	2	13	7:30	53.3
	38	3	3.0–2.0	2	12	3.54	46.6
	39	3	4.1–2.7	3	10	2:56	60.0
	40	3	3.7–2.6	3	13	4:25	26.6
	41	3	2.6–2.5	3	12	7:56	50.0
	42	3	4.6–3.2	4	11	2:51	53.3
	43	3	3.9–3.0	3	14	2:18	66.6
	44	3	3.0–2.3	3	11	3:58	40.0
	45	3	3.9–2.6	3	8	3:05	36.6
H.S.....	46	3	3.1–2.0	2	15	6:13	96.6
	47	3	3.8–2.7	3	11	3:30	30.0
	48	3	3.2–2.8	3	14	3:39	53.3
	49	2	2.1–1.9	2	4	:45	40.0
	50	3	3.5–2.9	3	9	2:10	36.6
	51	3	3.2–2.6	3	9	3:09	40.0

TABLE XIV—*Continued*

Subject	Grade	No. of Selections	Range in Rate	Minimum-Rate Group	Questions Attempted	Writing Time	Percentage of Questions Correct
C.....	52	3	5.2–3.8	4	9	1:03	43.3
	53	3	4.6–2.4	3	14	5:14	80.0
	54	3	5.8–4.2	5	11	1:55	36.6
	55	3	3.4–3.1	4	10	2:57	20.0
	56	3	4.1–3.5	4	5	1:11	10.0
	57	3	7.8–4.7	5	7	1:20	40.0
	58	3	5.0–3.0	3	14	3:23	53.3
	59	3	3.0–2.4	3	13	4:28	50.0

TABLE XIV A

SUMMARY OF TABLE XVI ON THE BASIS OF RANGE IN MINIMUM RATE

Group	Range in Minimum Rate	No. in Group	Grades	Range in Maximum Rates	Range in No. of Questions Attempted	Range in Percentage of Questions Correct	Range in Writing Time
1....	0.9–1.0	2	3, 6	1.2–1.4	9–10	50.0– 65.0	2:33– 6:53
2....	1.1–2.0	23	3, 4, 5, 6, 7, H.S.	1.5–3.4	3–15	13.3– 96.6	0:45–12:41
3....	2.1–3.0	26	3, 4, 5, 6, 7, H.S., C.	2.3–5.0	7–15	23.3–100.0	1:30– 7:56
4....	3.1–4.0	6	3, 6, H.S., C.	3.4–5.2	5–11	10.0– 80.0	1:03– 3:20
5....	4.1–5.0	2	C.	5.8–7.8	7–11	36.6– 40.0	1:20– 1:55

single ideas, but rather units of thought. One of the selections divided for scoring is shown below:

> Robin Hood sent a present / to Queen Katherine / with which she was so pleased / that she swore she would be a friend / to the noble outlaw / as long as she might live./ So one day / the queen went to her chamber / and called to her a page / of her company / and bade him make haste / and prepare to ride to Nottinghamshire / to find Robin Hood / in Sherwood Forest;/ for the queen had made a match / with the king,/ her archers against his archers,/ and the queen proposed to have Robin Hood / and his band / to shoot on her side / against the king's archers./

Tables XV and XVI show the records in this test for B. R. and W. E. Here again the advantage is with W. E. He reproduces on the average 6.5 per cent more points than does B. R. and reads a little more than twice as fast.

Table XVII gives the results for all subjects in this same test. This table is summarized in Table XVII A. The column of per-

centages in Table XVII refers to the number of points correct out of the total number of points in the three selections reproduced.

TABLE XV

RECORD OF B. R. IN REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Time for Writing
4.....	1:15	1.7	24.0	4:02
6.....	1:07	1.6	40.9	4:27
8.....	1:27	1.4	37.5	2:55
Total....	3:49	.....	.....	11:24
Average..	.....	.....	34.1	.....

TABLE XVI

RECORD OF W. E. IN REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Time for Writing
4.....	:28	4.6	40.0	3:58
6.....	:25	4.2	31.8	2:37
8.....	:34	3.6	50.0	3:00
Total....	1:27	.....	.....	9:35
Average..	.....	.....	40.6	.....

The reproduction of the third grade was oral, which accounts for the omission of the writing time. This change was made necessary by the fact that the writing proved to be a very great distraction for this grade.

SILENT READING FOR THE PURPOSE OF OUTLINING

A third method of measuring the results of silent reading was that of requiring, not a reproduction, but an outline, of the passage read. Three selections graded as easy, medium, and difficult were used. No pupils below the fourth grade took this test. The main points in each selection were determined, and the results scored according to the degree of accuracy with which they were selected and stated.

TABLE XVII

RECORD OF ALL SUBJECTS IN REPRODUCTION

Grade	Subject	No. of Selections	Range in Rate	Minimum-Rate Group	Percentage of Points Correct	Writing Time
3	1	3	1.9–0.6	1	51.0	.....
	2	3	3.3–1.3	2	37.7	.....
	3	3	3.3–1.3	2	40.8	.....
	4	3	3.6–1.1	2	81.6	.....
	5	2	2.1–1.5	2	61.7	.....
	6	3	2.7–0.8	1	54.1	.....
	7	3	3.2–0.8	1	68.4	.....
	8	3	1.1–0.4	1	53.1	.....
	9	2	2.0–1.8	2	44.1	.....
4	10	3	3.0–2.4	3	33.3	12:45
	11	3	3.0–2.3	3	44.4	11:47
	12	3	3.1–2.3	3	31.7	9:13
	13	3	1.9–1.5	2	38.8	13:33
	14	3	2.3–1.9	2	33.3	10:14
	15	3	1.8–1.4	2	11.1	9:17
	16	3	2.5–1.6	2	28.5	12:33
	17	3	2.1–1.3	2	23.8	23:00
5	18	3	1.9–1.7	2	31.9	5:26
	19	3	1.9–1.7	2	40.5	13:13
	20	3	2.0–1.8	2	31.9	7:29
	21	3	2.9–2.4	3	42.0	16:14
	22	3	2.4–0.7	1	27.5	18:06
	23	3	3.5–1.7	2	17.4	5:33
	24	3	3.1–2.5	3	36.2	8:29
	25	3	2.0–1.7	2	21.7	12:30
6	26	3	1.7–1.4	2	33.8	11:24
	27	3	3.0–1.7	2	42.2	13:23
	28	3	1.8–1.5	2	26.0	10:51
	29	3	2.2–1.8	2	26.7	11:32
	30	3	4.3–2.6	3	29.5	9:54
	31	3	4.6–3.6	4	40.8	9:35
	32	3	2.8–1.4	2	43.6	13:24
7	33	3	3.2–2.5	3	29.3	6:19
	34	3	2.3–1.4	2	19.3	5:20
	35	3	2.2–1.6	2	26.8	7:29
	36	3	2.7–1.9	2	46.0	15:25
	37	2	2.0–1.7	2	52.2	6:49
	38	3	2.8–2.6	3	47.5	9:40
	39	3	4.3–3.3	4	36.2	7:52
	40	3	5.9–3.9	4	45.0	8:26
	41	3	6.6–3.9	4	45.0	9:13
H.S.	42	3	3.7–3.1	4	54.6	6:53
	43	3	5.7–4.1	5	53.1	9:02
	44	3	2.4–1.5	2	36.4	9:11
	45	3	3.6–2.8	3	48.9	11:03
	46	3	3.7–2.5	3	64.5	12:00
	47	3	3.7–3.1	4	51.0	11:33
	48	3	4.0–3.2	4	49.4	10:12
	49	2	2.6–0.9	1	00.0	.....
	50	3	2.9–2.6	3	50.0	7:07
	51	3	3.6–2.9	3	44.7	9:24

TABLE XVII—*Continued*

Grade	Subject	No. of Selections	Range in Rate	Minimum-Rate Group	Percentage of Points Correct	Writing Time
C.....	52	3	4.4–3.9	4	21.8	4:08
	53	3	4.4–3.7	4	50.5	11:30
	54	3	4.7–4.5	5	33.3	7:19
	55	3	3.3–2.6	3	36.4	7:43
	56	3	3.5–2.6	3	23.9	6:40
	57	3	7.5–6.6	7	26.0	3:36
	58	3	2.8–2.7	3	54.1	9:25
	59	3	3.6–2.7	3	32.8	6:17

TABLE XVII A

SUMMARY OF TABLE XVII ON THE BASIS OF MINIMUM RATES

Group	Range in Minimum Rate	No. in Group	Grades	Range in Maximum Rate	Range in Percentage of Points Reproduced	Range in Writing Time
1.....	0.4–1.0	6	3, 5, H.S.	1.1–3.2	0.0–68.4	.....
2.....	1.1–2.0	25	3, 4, 5, 6, 7, H.S.	1.7–3.6	11.1–81.6	5:26–23:00
3.....	2.1–3.0	16	4, 5, 6, 7, H.S., C.	2.8–4.3	23.9–64.5	6:17–16:14
4.....	3.1–4.0	9	6, 7, H.S., C.	3.7–6.6	21.8–54.6	4:08–11:33
5.....	4.1–5.0	2	H.S., C.	4.7–5.7	33.3–53.1	7:19– 9:02
6.....	5.1–6.0	0	.....	.....	.....	.....
7.....	6.1–7.0	1	C.	7.5	26.0	3:36

In Tables XVIII and XIX the results in this test for B. R. and W. E. are given. Again the rate of W. E. is more than twice as fast as that of B. R. On the average there is little difference in the points correct. It should be noted that B. R. gets nothing correct in selection 4, while W. E. is credited with 50 per cent. Attention may also be called to the fact that the scores here are slightly lower than they were in the reproduction test. This may be due to the fact that outlining is more difficult than reproduction, or it may be due to the differences in material read.

Table XX gives the results for all subjects in outlining. The small percentage of points correct for college students is interesting because the type of work is the same as that required daily of college students. Table XX A summarizes this table.

RAPID SILENT READING

To determine the effect of rapidity upon the child's reading, a high-speed test was given. Three prose selections—one easy, one

TABLE XVIII

RECORD OF B. R. IN OUTLINING

Selection	Time	Rate	Percentage of Points Correct	Time for Writing
2.....	1:56	1.5	62.5	3:25
3.....	1:37	1.7	25.0	2:03
4.....	2:30	1.4	0.0	1:30
Total....	6:03	.....	.....	6:58
Average..	.....	.....	29.2	.....

TABLE XIX

RECORD OF W. E. IN OUTLINING

Selection	Time	Rate	Percentage of Points Correct	Time for Writing
2.....	:40	4.5	25.0	1:35
3.....	:44	3.7	25.0	1:25
4.....	:59	3.4	50.0	2:15
Total....	2:23	.....	.....	5:15
Average..	.....	.....	33.3	.....

medium, and one difficult—were read as rapidly as possible and then reproduced.

Tables XXI and XXII give the results for B. R. and W. E. in rapid reading. If the records for these two subjects in reproduction, outlining, and speed are compared, it will be noted that W. E. is able to double his speed without reducing his efficiency. In the case of B. R. the rate for the first selection is increased without a decrease in efficiency; in the second there is a slight increase in rate accompanied by a slight decrease in efficiency. Such results for B. R. indicate clearly that his work in reading is done at a much lower level than it might be done.

TABLE XX

RECORD OF ALL SUBJECTS IN OUTLINING

Grade	Subject	No. of Selections	Range in Rate	Minimum-Rate Group	Percentage of Points Correct	Writing Time
	10	3	2.6–2.2	3	20.0	8:55
	11	3	3.8–3.4	4	30.0	7:04
	12	3	6.2–4.2	5	10.0	5:46
	13	3	1.6–1.4	2	20.0	10:39
4.....	14	2	1.9–1.8	2	50.0	5:33
	15	2	1.6–1.5	2	0.0	3:12
	16	3	1.7–1.4	2	10.0	5:09
	17	3	1.6–1.5	2	15.0	6:24
	18	3	2.5–1.2	2	40.0	6:27
	19	3	4.0–2.5	3	30.0	5:12
	20	2	2.3–1.9	2	31.2	3:14
	21	3	3.5–2.6	3	40.0	9:48
5.....	22	3	2.6–1.7	2	20.0	8:11
	23	3	2.6–1.5	2	25.0	3:51
	24	3	3.7–2.7	3	20.0	4:44
	25	3	2.9–1.8	2	30.0	9:53
	26	3	1.7–1.4	2	35.0	6:58
	27	3	4.8–2.5	3	20.0	8:18
	28	3	2.4–2.0	2	50.0	7:26
6.....	29	3	3.1–2.2	3	35.0	2:19
	30	3	5.1–4.7	5	30.0	5:18
	31	3	4.5–3.4	4	30.0	5:15
	32	3	3.3–2.3	3	40.0	6:22
	33	3	3.8–2.8	3	40.0	4:19
	34	3	5.8–3.0	3	40.0	3:30
	35	3	2.2–1.9	2	40.0	5:54
	36	3	2.8–2.5	3	50.0	4:33
7.....	37	3	2.4–2.0	2	60.0	5:31
	38	3	2.8–2.0	2	30.0	3:53
	39	3	4.1–3.7	4	40.0	4:41
	40	3	5.5–3.7	4	60.0	5:28
	41	3	4.3–3.3	4	60.0	6:37
	42	3	5.0–3.1	4	70.0	4:49
	43	3	5.0–3.9	4	70.0	7:03
	44	3	2.4–2.2	3	55.0	4:17
	45	3	4.3–2.4	3	65.0	5:34
H.S.....	46	3	4.5–2.2	3	80.0	7:27
	47	3	5.9–4.4	5	60.0	4:35
	48	3	4.5–3.9	4	70.0	5:62
	49	.....	.....	.....	.....	.....
	50	3	4.1–1.6	2	75.0	3:58
	51	3	4.4–3.3	4	60.0	3:45
	52	3	4.6–3.6	4	40.0	5:18
	53	3	4.0–2.8	3	70.0	8:12
	54	3	6.9–4.5	5	30.0	4:33
C.....	55	3	3.7–3.0	3	60.0	3:28
	56	3	4.2–3.0	3	60.0	4:17
	57	3	8.6–7.8	8	20.0	2:08
	58	3	5.3–3.3	4	80.0	5:05
	59	3	3.4–3.0	3	60.0	5:09

TABLE XX A

SUMMARY OF TABLE XX ON THE BASIS OF MINIMUM RATES

Group	Range in Minimum Rate	No. in Group	Grades	Range in Maximum Rate	Range in Percentage of Points Reproduced	Range in Writing Time
1.....	0.0–1.0	0	.....	.....	.....	.....
2.....	1.1–2.0	16	4, 5, 6, 7, H.S.	1.6–4.1	0–75	3:12–10:39
3.....	2.1–3.0	17	4, 5, 6, 7, H.S., C.	2.4–5.8	20–80	2:19– 9:48
4.....	3.1–4.0	11	4, 6, 7, H.S., C.	3.8–5.5	30–80	3:45– 7:04
5.....	4.1–5.0	4	4, 6, H.S., C.	5.1–6.9	10–60	4:33– 5:46
6.....	5.1–6.0	0	.....	.....	.....	.....
7.....	6.1–7.0	0	.....	.....	.....	.....
8.....	7.1–8.0	1	C.	8.6	20	2:08

TABLE XXI

RECORD OF B. R. IN RAPID SILENT READING

Selection	Time	Rate	Percentage of Points Correct	Time for Writing
2.....	:31	3.1	30.0	2:03
3.....	:45	2.3	26.1	2:06
4.....	1:00	1.9	0.0	:58
Total....	2:16	.....	.....	5:07
Average..	.....	.....	18.7	.....

TABLE XXII

RECORD OF W. E. IN RAPID SILENT READING

Selection	Time	Rate	Percentage of Points Correct	Time for Writing
2.....	:12	7.9	75.0	3:05
3.....	:16	6.5	21.7	2:33
4.....	:23	5.1	13.3	4:00
Total....	:51	.....	.....	9:38
Average..	.....	.....	36.6	.....

Tables XXIII and XXIII A give the results for all subjects in this test.

TABLE XXIII

RECORD OF ALL SUBJECTS IN RAPID SILENT READING

Grade	Subject	No. of Selections	Range in Rate	Minimum-Rate Group	Percentage of Points Correct	Writing Time
	1	2	2.9–1.7	2	31.0	.....
	2	2	3.9–3.4	4	51.7	.....
	3	2	3.9–3.2	4	27.6	.....
	4	2	4.7–2.9	3	68.9	.....
3.....	5	2	3.3–2.8	3	24.1	.....
	6	1	3.1	4	66.6	.....
	7	2	5.2–3.4	4	60.3	.....
	8	2	1.4–1.2	2	32.7	.....
	9	2	2.4–1.7	2	24.1	.....
	10	3	3.6–2.5	3	30.1	10:06
	11	3	3.9–3.0	3	30.8	8:27
	12	3	5.8–3.2	4	13.7	5:36
4.....	13	2	2.3–1.2	2	19.7	5:14
	14	2	2.5–2.2	3	13.9	5:27
	15	2	2.1–1.8	2	13.9	5:13
	16	3	1.9–1.2	2	19.1	14:00
	17	3	2.0–1.5	2	5.5	12:45
	18	3	2.9–1.8	2	32.8	6:09
	19	3	3.9–3.4	4	9.6	3:27
	20	3	2.9–2.8	3	15.0	6:52
5.....	21	3	4.3–3.0	3	39.7	11:48
	22	3	3.6–1.8	2	18.5	10:15
	23	3	3.9–2.7	3	12.3	5:48
	24	3	5.3–4.0	4	35.6	8:28
	25	3	3.9–2.3	3	8.9	6:53
	26	3	3.1–1.9	2	16.4	5:07
	27	3	4.7–3.0	3	34.2	8:56
	28	3	3.8–2.3	3	9.6	5:08
6.....	29	3	3.6–2.5	3	17.8	5:52
	30	3	5.3–4.5	5	27.4	7:06
	31	3	7.9–5.1	6	32.8	9:38
	32	3	3.4–1.9	2	27.4	8:49
	33	3	3.8–2.8	3	28.7	4:44
	34	3	4.2–2.1	3	25.3	5:11
	35	3	3.1–2.2	3	12.3	5:19
	36	3	4.0–3.0	3	38.3	7:33
7.....	37	3	3.4–2.1	3	35.6	5:30
	38	3	5.6–3.1	4	26.7	6:39
	39	3	5.6–4.0	4	54.8	8:23
	40	3	4.5–3.9	4	35.6	8:05
	41	3	6.3–3.9	4	35.6	8:55
	42	3	5.6–4.9	5	58.9	5:16
	43	3	9.5–6.5	7	39.7	3:59
	44	3	3.3–2.4	3	35.2	4:55
	45	3	5.6–4.2	5	32.8	3:30
H.S.....	46	3	8.7–6.8	7	47.9	4:53
	47	3	6.1–4.9	5	45.2	6:25
	48	3	8.6–7.3	8	35.6	5:02
	49	1	1.2	2	0.0	.....
	50	3	5.6–4.0	4	35.6	5:47
	51	3	5.6–4.0	4	34.2	3:49

TABLE XXIII—*Continued*

Grade	Subject	No. of Selections	Range in Rate	Minimum-Rate Group	Percentage of Points Correct	Writing Time
C.....	52	3	6.0–3.9	4	30.1	4:00
	53	3	4.0–3.1	4	48.6	8:46
	54	3	6.1–5.1	6	40.4	5:51
	55	3	4.1–3.1	4	36.3	5:06
	56	3	5.9–3.3	4	23.9	4:23
	57	3	9.4–7.3	8	33.5	2:21
	58	3	5.6–5.5	6	42.4	4:41
	59	3	5.0–4.2	5	20.5	4:14

TABLE XXIII A

SUMMARY OF TABLE XXIII ON THE BASIS OF MINIMUM RATES

Group	Range in Minimum Rate	No. in Group	Grades	Range in Maximum Rate	Range in Percentage of Points Correct	Range in Writing Time
1.....	0.0–1.0	0	.....	.....	.....	.....
2.....	1.1–2.0	12	3, 4, 5, 6, H.S.	1.2–3.6	0.0–32.8	5:07–14:00
3.....	2.1–3.0	18	3, 4, 5, 6, 7, H.S.	2.5–4.7	8.9–68.9	4:44–11:48
4.....	3.1–4.0	17	3, 4, 5, 7, H.S., C.	3.1–6.3	9.6–66.6	3:27– 8:55
5.....	4.1–5.0	5	6, H.S., C.	5.0–6.1	20.5–58.9	3:30– 7:06
6.....	5.1–6.0	3	6, C.	5.6–7.9	32.8–42.4	4:41– 9:38
7.....	6.1–7.0	2	H.S.	8.7–9.5	39.7–47.9	3:59– 4:53
8.....	7.1–8.0	2	H.S., C.	8.6–9.4	33.5–35.6	2:21– 5:02

OTHER TESTS IN SILENT READING

The tests in silent reading which have been used so far are open to the objection that our knowledge of the subject's ability in reading is gained through an elaborate reproduction, which is itself a complex involving the use of language powers of a high order. In order to remove this complication in part, three tests were given in which the language required for the response was reduced to a minimum. In order to determine how rapidly a body of printed matter can be hastily read, the subject was given a newspaper and told to find as quickly as possible an article with a certain title. In addition to recording the time required by the subject to find the article, his method was also graded. Subjects who made a detailed inspection of the various columns were given low grades; those who made a general inspection, which was not too hasty, were given high grades. In addition to this first type of test not requiring language, which will be referred to as the newspaper test,

a modification of the Woodworth and Wells's easy direction test was given and Courtis' normal reading test was given. Tables XXIV–XXVI A give the results and summaries in these tests. In these tables B. R. is No. 26 and W. E. is No. 31. In each of the tests the great difference between these two subjects is their rates. It might be thought that B. R. is slow in all his reactions, but his physical-education teacher reports that he plays baseball and basket-ball with speed and accuracy.

In the newspaper test it should be noted that every subject but one succeeded in finding the article and that, with the exception of Group 3, each group has in it one or more persons who receive the grade P.

In the Woodworth-Wells direction test the material to be read is very simple, and the response called for is not at all complex. On the other hand, the test is somewhat novel, and undoubtedly some time is taken by most subjects in adjusting themselves to it. Thus elements other than comprehension are introduced. The time required for the response also varies, and the words used have different degrees of familiarity for the different subjects. The exact influence of these factors cannot be determined, but they doubtless contribute to the variations in time, which extend from 49 seconds for one subject to 6 minutes and 17 seconds for another.

With respect to the Courtis test, attention need be called only to the large individual differences which are found in rate and the percentage of points correct.

COMPARISON OF RESULTS FOR ALL TESTS

Objections may be raised to all the methods of testing comprehension, because these in every case involve memory. Presumably one may lose, even in the short intervals here involved, some of that which he gains through first impressions. This criticism added to the objection raised to all the reproduction tests—that they involve the use of language—has led some to the conclusion that a part at least of the large variations found in reading ability are due to defects in the tests rather than to real differences in ability to read. The large individual variations in the last three tests are therefore very interesting, because in all three tests the language element is reduced to a minimum and in the first two the memory

TABLE XXIV

RECORD OF ALL SUBJECTS IN THE NEWSPAPER TEST

Grade	Subject	Time	Group	Method	Result
	10	6:02	7	F	+
	11	1:05	2	G+	+
	12	1:01	2	G	+
	13	1:48	2	G	+
4	14	6:08	7	P	+
	15	5:30	6	F	+
	16	2:53	3	F	+
	17	5:28	6	G	+
	18	0:59	1	G	+
	19	2:09	3	G	+
	20	6:36	7	G	+
	21	4:11	5	P	+
5	22	1:41	2	G	+
	23	5:14	6	P	−
	24	2:30	3	F	+
	25	7:03	8	P−	+
	26	3:30	4	F	+
	27	4:05	5	F	+
	28	1:20	2	G	+
6	29	5:30	6	P	+
	30	1:06	2	G+	+
	31	0:38	1	P	+
	32	2:05	3	F	+
	33	2:00	2	G	+
	34	1:21	2	G+	+
	35	0:51	1	G	+
	36	1:49	2	F	+
7	37	2:30	3	G	+
	38	2:40	3	F	+
	39	3:02	4	P	+
	40	0:46	1	G	+
	41	1:23	2	G	+
	42	0:31	1	E	+
	43	0:32	1	G	+
	44	0:36	1	G	+
	45	0:48	1	G	+
H.S.	46	1:45	2	P	+
	47	0:28	1	G	+
	48	0:59	1	G	+
	49	1:57	2	G	+
	50	0:27	1	G+	+
	51	1:00	1	G	+
	52	0:38	1	G+	+
	53	0:45	1	G	+
	54	1:26	2	G	+
	55	0:40	1	G+	+
C	56	1:15	2	F+	+
	57	0:25	1	F+	+
	58	0:32	1	G	+
	59	0:31	1	P	+

TABLE XXIV A

SUMMARY OF TABLE XXIV ON THE BASIS OF RANGE IN TIME

Group	Range in Time	No. of Subjects	Grades	Range in Grades
1.....	0:25–1:00	18	5, 6, 7, H.S., C.	P–E
2.....	1:01–2:00	14	4, 5, 6, 7, H.S., C.	P–G+
3.....	2:01–3:00	6	4, 5, 6, 7	F–G
4.....	3:01–4:00	2	6, 7	P–F
5.....	4:01–5:00	2	5, 6	P–F
6.....	5:01–6:00	4	4, 5, 6	P–G
7.....	6:01–7:00	3	4, 5	P–G
8.....	7:01–8:00	1	5	P–

element plays no part. Other comparisons between the results for these various tests follow immediately. Table XXVII makes possible a comparison of minimum rates for the different types of reading. The direction test and newspaper test are omitted because it is impossible to give results in the form of rate. The table has the same general plan as the preceding tables which have distributed subjects according to rates, and no further explanation is necessary.

In making the comparisons indicated in Table XXVII we must remember that the material read in each test was different from that in any other test. However, a careful comparison of the different selections leads the author to believe that all the differences shown in the table are not due to differences in the difficulty of the material read. This emphasizes the very great need for a much larger collection of standardized selections for tests in reading than is now at hand. Material selected from other kinds of discourse than descriptive and narrative prose should be graded in this manner.

Returning now to a discussion of the table at hand, we may note the following points:

1. If the results of oral reading of the various types are compared, it will be seen that the rates for both poetry and oratory are faster than the rates in the prose column. While this may indicate that there were differences in the difficulty of selections chosen for the tests, it is not probable that differences in rate are due entirely to the differences in the material read. Attention has already been called to the fact that most of the readers did not exhibit any

TABLE XXV

RECORD OF ALL SUBJECTS IN THE WOODWORTH-WELLS DIRECTION TEST

Grade	Subject	Percentage of Questions Correct	Writing Time	Group	Grade	Subject	Percentage of Questions Correct	Writing Time	Group
3	1	75.0	3:56	4	7	33	95.0	2:05	3
	2	95.0	2:07	3		34	90.0	2:12	3
	3	85.0	2:48	3		35	90.0	1:39	2
	4	95.0	3:07	4		36	100.0	2:04	3
	5	75.0	3:49	4		37	95.0	1:35	2
	6	75.0	4:01	5		38	100.0	1:37	2
	7	95.0	2:57	3		39	95.0	1:25	2
	8	55.0	6:17	7		40	100.0	1:01	2
	9	75.0	3:47	4		41	100.0	1:23	2
4	10	100.0	3:20	4	H.S.	42	100.0	0:54	1
	11	95.0	2:17	3		43	90.0	0:49	1
	12	70.0	2:56	3		44	95.0	1:39	2
	13	90.0	3:19	4		45	100.0	1:08	2
	14	85.0	2:46	3		46	95.0	1:03	2
	15	75.0	4:19	5		47	95.0	1:16	2
	16	95.0	3:01	4		48	100.0	0:58	1
	17	95.0	3:33	4		49	95.0	2:01	3
						50	95.0	0:53	1
	18	95.0	1:57	2		51	85.0	1:21	2
	19	100.0	2:28	3					
	20	85.0	2:18	3	C	52	100.0	1:15	2
	21	90.0	2:25	3		53	100.0	0:56	1
5	22	85.0	2:35	3		54	100.0	1:10	2
	23	100.0	2:37	3		55	95.0	1:26	2
	24	90.0	2:20	3		56	95.0	1:01	2
	25	90.0	3:37	4		57	90.0	0:52	1
						58	100.0	0:53	1
	26	85.0	2:50	3		59	70.0	1:00	1
	27	90.0	3:18	4					
	28	95.0	2:20	3					
6	29	85.0	2:59	3					
	30	95.0	1:56	2					
	31	95.0	1:44	2					
	32	90.0	2:12	3					

TABLE XXV A

SUMMARY OF TABLE XXV ON THE BASIS OF RANGE IN TIME

Group	Range in Time	No. of Subjects	Grades	Range in Percentage of Points Correct
1	0:49–1:00	8	H.S., C.	70–100
2	1:01–2:00	18	5, 6, 7, H.S., C.	85–100
3	2:01–3:00	20	3, 4, 5, 6, 7, H.S.	70–100
4	3:01–4:00	10	3, 4, 5, 6	75–100
5	4:01–5:00	2	3, 4	75
6	5:01–6:00	0	.....	.....
7	6:01–7:00	1	3	55

TABLE XXVI

RECORD OF ALL SUBJECTS IN COURTIS' NORMAL READING TEST

Grade	Subject	Rate	Rate Group	Percentage of Points Correct	Writing Time
	10	1.8	2	75.0	3:58
	11	3.2	4	41.6	2:07
	12	2.4	3	50.0	2:46
4	13	1.0	1	75.0	4:36
	14	0.8	1	79.2	3:20
	15	1.1	2	62.4	5:05
	16	1.3	2	79.2	4:17
	17	0.9	1	58.2	4:30
	18	1.3	2	83.2	3:06
	19	1.5	2	70.7	4:10
	20	1.5	2	70.7	3:18
5	21	1.9	2	83.2	3:08
	22	1.3	2	87.4	2:32
	23	1.8	2	58.2	3:32
	24	2.7	3	50.0	3:00
	25	1.5	2	66.6	3:40
	26	1.5	2	79.2	3:26
	27	2.9	3	70.7	.....
	28	1.3	2	50.0	2:35
6	29	1.0	1	62.4	5:05
	30	1.0	1	66.6	2:27
	31	3.1	4	75.0	2:50
	32	2.5	3	70.7	3:09
	33	2.4	3	91.6	2:33
	34	2.2	3	70.8	2:52
	35	1.9	2	75.0	2:11
	36	1.8	2	79.2	3:05
7	37	1.8	2	62.5	3:13
	38	2.4	3	75.0	2:25
	39	2.6	3	83.3	2:03
	40	3.3	4	70.8	2:09
	41	3.7	4	83.3	2:16
	42	2.3	3	79.2	1:23
	43	2.8	3	70.8	1:27
	44	1.5	2	79.2	2:29
	45	2.2	3	75.0	2:25
H.S.	46	2.0	2	79.2	1:40
	47	4.7	5	75.0	1:55
	48	2.5	3	87.5	1:21
	49	1.6	2	66.6	3:25
	50	2.9	3	79.2	2:37
	51	2.1	3	87.5	2:05
	52	2.7	3	50.0	1:15
	53	2.2	3	83.3	1:51
	54	3.9	4	66.6	1:46
C	55	2.4	3	66.6	1:51
	56	2.4	3	66.6	1:54
	57	5.5	6	54.1	0:52
	58	3.5	4	75.0	2:11
	59	3.1	4	45.8	1:35

TABLE XXVI A

SUMMARY OF TABLE XXVI ON THE BASIS OF MINIMUM RATE

Group	Range in Rate	No. of Subjects	Grades	Range in Points Correct	Range in Writing Time
1.....	.8–1.0	5	4, 6	58.2–79.2	2:27–5:05
2.....	1.1–2.0	18	4, 5, 6, 7, H.S.	50.0–87.4	1:40–5:05
3.....	2.1–3.0	18	4, 5, 6, 7, H.S., C.	50.0–91.6	1:15–3:09
4.....	3.1–4.0	7	4, 6, 7, C.	41.6–83.3	1:35–2:50
5.....	4.1–5.0	1	H.S.	75.0	1:55
6.....	5.1–6.0	1	C.	54.1	0:52

marked differences in their modes of attacking reading matter of the various types. Yet the good-natured protests made by several of the subjects when they were confronted with the poetry and oratory, and the remarks which many of them made about not being able to get meaning from such selections, lead to the conclusion

TABLE XXVII

COMPARISON OF MINIMUM RATES FOR VARIOUS TYPES OF READING

Range in Minimum Rates	Oral			Silent					
	No. of Subjects in			No. of Subjects in					
	Prose	Poetry	Oratory	Prose (Answering Questions)	Poetry (Answering Questions)	Reproduction	Outlining	Speed	Courtis
0–1.0	23	3	6	5	2	6	0	0	5
1.1–2.0	29	24	19	28	23	25	16	12	18
2.1–3.0	7	27	17	17	26	16	17	18	18
3.1–4.0	.....	5	5	8	6	9	11	17	7
4.1–5.0	.....	.....	.....	1	2	2	4	5	1
5.1–6.0	.....	.....	.....	.....	.....	0	0	3	1
6.1–7.0	.....	.....	.....	.....	.....	1	0	2	.....
7.1–8.0	.....	.....	.....	.....	.....	.....	1	2	.....

that these types of material present peculiar difficulties to the reader. This fact would seem to show that poetry and oratory are difficult rather than easy. The increase in rate cannot therefore be explained on the assumption that the reading of poetry and oratory is more easily accomplished than the reading of narrative and descriptive prose. The difference lies rather in the way

in which the reading was done. That is, the reading of poetry and oratory was a mechanical process for most of the readers. They hurried through the selections and made as few pauses as possible. In other words, it was a matter of pronouncing so many words, and hence the rate was more rapid.

2. If the rates for the oral reading of prose are compared with those of silent reading of prose for the purpose of answering questions, a higher speed is noted, on the average, for silent reading. However, an examination of individual records shows that in 28 cases the oral reading is more rapid than the silent reading. Such results are probably to be explained by the fact that most of the training given in the school is in oral reading. Oral reading becomes the dominant fact in a child's experience, and whatever natural tendency he may have toward rapid silent reading is checked by the system of training of the school.

3. A comparison of the rates of silent reading of prose in preparation for answering questions and for reproduction shows that a few individuals read more rapidly in the latter test. The introspections of the adult subjects on this point were interesting. In nearly every case they were of the opinion that the reading for reproduction was more rapid than reading to prepare for questions, because they "rushed through the selection to see what it was about."

4. The increase in the rate of reading for outlining was explained by certain adults as due to the fact that a large part of the material was neglected. If they found a main point in the topic sentence of a paragraph, the remaining portion of the paragraph was neglected altogether or looked through very hurriedly.

5. The increase to be seen in the speed test is very important, because it shows that a large number of the subjects can increase their rate of reading when urged to do so. This point will be discussed further in the consideration of Table XXVIII.

The differences which exist between different kinds of reading are important from at least two points of view: First, the training which the school usually gives in reading is a general training, and the child in an uncontrolled way is left to apply it to all phases of reading. It is evidently desirable that training be given in several distinct types of reading. Secondly, the promiscuous arrangement

TABLE XXVIII

INDIVIDUAL AND GRADE DISTRIBUTIONS FOR SEVEN SILENT-READING TESTS

Group	Degrees of Attainment in Tests	Prose (Answering Questions)	Grade	Poetry (Answering Questions)	Grade	Reproduction	Grade	Speed	Grade	Outlining	Grade	Courtis	Grade	Direction	Grade
1.....	0–10.0	0	0	1.7	C.	1.7	H.S.	8.5	4, 5, 6, H.S.	6.1	4	0	0	0	0
2.....	10.1–20.0	0	0	6.8	4, 5, 6, C.	5.1	4, 5, 7	18.6	4, 5, 6, 7	14.3	4, 5, 6, C.	0	0	0	0
3.....	20.1–30.0	1.7	C	8.5	5, 7, H.S.	20.3	4, 5, 6, 7, C.	16.9	3, 6, 7, C.	16.3	4, 5, 6, 7, C.	0	0	0	0
4.....	30.1–40.0	5.1	3, 4, C.	25.4	4, 5, 6, 7, H.S., C.	23.7	3, 4, 5, 6, 7, H.S., C.	37.3	3, 4, 5, 6, 7, H.S., C.	22.4	5, 6, 7, C.	0	0	0	0
5.....	40.1–50.0	10.2	3, 4, 7, H.S., C.	20.3	3, 4, 5, 6, 7, C.	27.1	3, 4, 5, 6, 7, H.S.	8.5	H.S., C.	6.1	4, 6, 7	12.0	4, 5, 6, C.	0	0
6.....	50.1–60.0	27.1	3, 4, 5, 6, H.S., C.	25.4	3, 4, 5, 6, 7, H.S., C.	15.3	3, 7, H.S., C.	5.1 1	3, 7, H.S.	18.4	7, H.S., C.	6.0	4, 5, C.	1.7	3
7.....	60.1–70.0	27.1	3, 4, 5, 6, 7, H.S., C.	3.4	3, H.S.	5.1	3, H.S.	5.	3	10.2	H.S., C.	18.0	4, 5, 6, 7, H.S., C.	3.4	4, C.
8.....	70.1–80.0	22.0	3, 5, 6, 7, H.S.	3.4	3, C.	0	0	0	0	6.1	H.S., C.	46.0	4, 5, 6, 7, H.S., C.	8.5	3, 4
9.....	80.1–90.0	6.8	H.S., C.	1.7	3	1.7	3	0	0	0	.....	16.0	5, 7, H.S., C.	28.8	3, 4, 5, 6, 7, H.S., C.
10.....	90.1–100.0	0	0	3.4	3, H.S.	0	0	0	0	0	.....	2.0	7	57.6	3, 4, 5, 6, 7, H.S., C.

of reading material which usually prevails in school readers seems to indicate that makers of readers are not aware of the differences which have been pointed out. The mixing of many kinds of material may be justified on the ground that various types of training are desirable. Or it may appear, when careful school experiments are carried out, that specialized training will be more effective. In that case the mixture of passages will be superseded.

Table XXVIII makes possible a comparison of the results achieved in the various silent-reading tests, with the exception of the newspaper test, which is omitted because the results cannot be expressed in percentages. For convenience the percentages of answers or questions correct are divided into groups of ten, as 0–10.0, 10.1–20.0, 20.1–30.0, etc. In order to make the results comparable, the number of individuals who fall in each group is expressed as a percentage of the total number taking the test. That is, if three persons belong in Group 2 (10.1–20.0) and 59 persons have taken the test, then this is expressed as 5.1 per cent. In addition to the percentage of persons within the various groups, the school grades to which they belong are indicated in columns headed "Grades."

If the results as shown in the table are considered, the following points become clear:

1. The results of silent reading preparatory to answering questions on poetry have a wider range than the results for any other test and when compared with the results for prose show clearly that poetry presents a different problem to the reader.

2. If the results of reading prose for reproduction are compared with the results for answering questions, it will be seen that the attainment is not so high in reproduction as in answering questions. This evidently means that the problem presented to the reader in the reproduction test is more difficult than that presented in the test requiring answering of questions. Evidently the problem of the reader in the reproduction test has in it two elements: first, the method of attacking the reading matter may be different from that required in answering questions; secondly, the reproduction of the material read may be more difficult than writing answers to questions. Doubtless both factors enter into the results noted above.

3. There is a marked falling off in power to give back the material read in the speed tests. An earlier discussion has shown that rate is increased in this test, but the relative lack of comprehension shows that increase in rate was obtained at the expense of the amount of reproduction. However, if the individual records in this test are studied, as shown in Table XVII, it will be seen that a number of individuals do increase their rate without decreasing the amount which they reproduce.

4. The most interesting point brought out by the outlining test is the separating of the subjects into two distinct divisions with the dividing point at the fifth group. No subject below the seventh grade is in Groups 6, 7, or 8—an indication that previous training plays a large part in the results obtained from such a test.

5. The much higher accomplishment indicated in the Courtis and direction tests shows that these tests are much easier than any of the others.

6. If the distribution of grades in the various groups as indicated in the "Grade" columns is considered, it will be seen that an increase in achievement is directly related to an increase in school training.

The very wide distribution of the third grade throughout the various groups is interesting. In the first test third-grade pupils appear in five of the seven groups represented, while in the second test pupils of this grade appear in six of the ten groups.

It is hardly necessary to say that such wide variations in ability as those cited above present a very real problem to those who are giving instruction in reading. It is evident that devices and methods for increasing the efficiency of the poor reader need to be developed and placed at the disposal of the teachers who deal with the pupils from day to day. It is equally evident that good readers ought to be discovered by adequate methods and ought to be given a type of training appropriate to their achievements, even when they belong in the lower school grades.

OTHER REPRODUCTION TESTS

In addition to the tests already given, certain subjects were selected for supplementary tests. The first tests noted here are reproduction tests. In these the subjects read the material

silently and reproduced it orally. In a second series the material was read aloud to the subject, and the reproduction was made in writing. The purpose of introducing such tests was to get data which could be compared with the results already obtained in the simple tests described in earlier sections. The reading matter was selected from the same set of readers as that mentioned before. The results given are based upon two selections, instead of three as in the preceding reproduction tests. For the third grade selections were taken from the third and fourth readers; for the fourth grade they were taken from the fourth and fifth readers, etc. Fourteen persons took the supplementary tests. Two subjects are included from each of the grades. One of these in each case was a poor reader, while the second was one of the better readers. In the tables which follow the poor readers are marked "P" and the good readers are indicated by "G." The numbers which indicate the various subjects are the same as those used in the preceding tables.

TABLE XXIX

RECORD OF FOURTEEN SUBJECTS IN SECOND GROUP OF REPRODUCTION TESTS

SUBJECT	ORAL REPRODUCTION				WRITTEN REPRODUCTION		
	Grade	Percentage of Points Correct	Reading Ability	Rate	Percentage of Points Correct	Writing Time	Percentage of Points Correct in Reproduction—
1.....	3	16.6	P	1.6–1.4	22.2	7:05	51.0
7.....	3	29.7	G	2.7–2.5	45.5	11:47	68.4
17.....	4	38.4	P	2.1–1.5	29.6	9:17	23.8
10.....	4	44.2	G	3.4–2.2	40.7	9:35	33.3
19.....	5	42.6	P	3.0–2.3	30.5	7:34	40.5
24.....	5	37.7	G	4.3–3.7	45.7	9:56	36.2
26.....	6	19.6	P	3.6–2.9	23.1	4:00	33.8
31.....	6	27.8	G	6.0–4.9	35.5	7:04	40.8
36.....	7	40.9	P	2.7–2.3	27.1	5:00	46.0
41.....		47.5	G	3.6–3.6	52.1	8:40	45.0
49.....	H.S.	31.1	P	2.3–2.0	15.2	3:04	0.0
45.....	H.S.	38.5	G	3.2–2.7	72.9	9:10	48.9
56.....	C.	22.9	P	2.9–2.3	19.8	4:54	23.9
54.....	C.	31.9	G	5.1–4.0	48.9	5:21	33.3

Table XXIX gives the results. A final column, borrowed from Table XVII, p. 44, is added at the right of this table. This final column gives some comparative material of interest. Attention

is called to the large variations in reading rate for oral reproduction and to the fact that, except in the fifth grade, the good readers reproduced more points than the poor readers. The range of points reproduced by poor readers is from 16.6 to 42.6 per cent, that by good readers from 27.8 to 47.5 per cent. In reproducing material which had been read to them the subjects show large variations in writing time, and in every case the good readers excel the poor readers. The range in points reproduced by the poor readers is from 15.2 to 30.5 per cent, that by good readers from 35.5 to 72.9 per cent. By comparing the third, sixth, and eighth columns we find that subjects Nos. 1, 7, 26, 31, 36, and 56 reproduce more points in the earlier test than in either of the present ones.

This same group of fourteen were given the part-whole test, the opposite test, the genus-species test, and the completion test to determine whether there was a difference in the amount of knowledge which the poor and good readers have of language forms and their meaning. These tests are summarized in Table XXX. In this table the first column shows the type of test; the second column, the number of words or elisions in each test; the third to sixth show the results; and the last column shows the grades in which the good readers fail to do better than the poor readers in the given test.

TABLE XXX

SUMMARY OF SEVEN TESTS GIVEN FOURTEEN SELECTED SUBJECTS

TEST	WORDS OR ELISIONS	NO. OF ATTEMPTS		RANGE IN PERCENTAGE OF POINTS CORRECT		EXCEPTIONS
		Poor Readers	Good Readers	Poor Readers	Good Readers	Grades
Part-whole 1...	20	100	108	20–45	40– 60	3 and 5
Part-whole 2...	20	114	118	10–60	55– 80	C
Opposite 2.....	20	127	140	70–90	80–100	C
Opposite 3.....	20	82	132	10–65	30– 80	0
Genus-species 1	20	126	137	40–85	85–100	3
Completion A..	16	91	109	18.7–93.7	75–100	4 and 7
Completion B..	21	113	144	23.8–71.4	66.6– 95.2	0

Table XXX brings out the following points:

1. In every case the good readers attempted more points than did the poor readers.

2. In every case the range of percentage of points correct for the good readers is higher than that of the poor readers.

3. The number of exceptions in which the good reader fails to do better than the poor reader of his grade is small. The chances for such exceptions total forty-nine for all the tests, so that the exceptions which do occur are 14.2 per cent of the total possibilities.

These results indicate clearly that good readers have greater ability in reacting to language symbols and their meaning. Doubtless this ability is one element which enters into rapid reading, just as the ability to react to certain number combinations is an element which makes for speed in arithmetical operations.

In summarizing the tables presented in this chapter a great deal has been omitted which might have been said about individual cases. The later investigations to be reported in this paper take advantage of the personal information given in the tables but not commented on at length.

Furthermore, there is some personal information not given in the tables, such as the following: One of the high-school pupils (No. 49) dropped out of school while in the grades. When a class in industrial training was organized in the University High school he entered. His mechanical work was so good that he was encouraged, after some work in the industrial class, to enter the high school as a regular student. His work in the academic subjects, where a large amount of reading is required, is very poor,

TABLE XXXI

RECORD OF SUBJECT NO. 22 IN SILENT READING OF PROSE

Selection	Rate	Questions Correct	Selection	Rate	Questions Correct
1.....	2.3	4.0	6.....	1.7	5.0
2.....	1.3	5.0	7.....	1.4	1.0
3.....	1.0	4.0	8.....	1.0	2.0
4.....	1.5	3.5	9.....	.8	1.5
5.....	.9	2.0			

yet his mechanical work is of a very high order. One of his instructors in shopwork says that the boy can interpret a blueprint as quickly as any boy who has had work in the shop. The tables

show that this boy made a very poor record in all the tests so far given—a record which seems to indicate that his difficulty is more fundamental than anything revealed by the preceding tests.

Another case very similar to the preceding one—namely, that of pupil No. 22—shows difficulties of reading not quite so marked. This boy's reading also shows marked variations in rate both in silent and in oral reading. Table XXXI was compiled from the record of No. 22 to show how erratic is his record for nine passages which were all known to be of like difficulty for a large number of other readers.

CHAPTER III

MOTOR PHASES OF READING

The preceding chapter has given data as to rate and quality of oral reading as well as rate and comprehension in silent reading. It is the purpose of this chapter to enter upon a detailed study of certain motor processes involved in reading, to determine whether any of the differences found in oral and silent reading are directly related to differences in motor processes.

In order to get data on those phases of reading which are essentially motor in their nature, four records were made for each reader: first, the rate of vocalization was tested; secondly, careful observations were made on the amount of vocalization during silent reading; thirdly, pneumographic records of the breathing movements during oral reading were made; and fourthly, eye-movement records were made for both oral and silent reading.

RATE OF VOCALIZATION

The test for rate of vocalization consisted in having the subjects pronounce as rapidly as possible lists of thirty easy words, taken from the selections used in the oral- and silent-reading tests. The same thirty words were arranged in three lists, with the order of the words reversed in the second list and entirely rearranged in the third. The time for each list was taken and the rate determined.

A second test with the same general purpose consisted in having the subject count repeatedly from 1 to 10 as rapidly as possible for thirty seconds. The total number counted was recorded, and the number counted per second calculated. The much higher rate for counting than for pronouncing, as shown in Table XXXII, is probably due to the fact that in counting the subject knows just what is to follow in each case. Then, too, in the case of the numerals all the words were monosyllables except one, while in the lists of words twenty were monosyllables, nine had two syllables, and one had three. It is true in general that the rate in counting is

greater than the rate in reading, while rate of pronouncing lists of words falls between the maximum and minimum reading rate of a person, usually nearer the minimum than the maximum.

TABLE XXXII

RECORD OF ALL SUBJECTS IN VOCALIZATION TESTS

Grade	Subject	Pronouncing Rate	Counting Rate	Oral-Reading Rate
3	1	0.8	5.3	2.5–0.8
	2	1.9	4.0	3.3–1.5
	3	1.9	5.3	4.8–1.3
	4	2.3	5.0	3.4–1.2
	5	1.1	4.3	2.3–1.1
	6	1.3	3.0	2.7–1.3
	7	1.5	2.6	2.9–1.8
	8	0.4	3.6	1.7–0.8
	9	0.8	4.7	2.7–1.3
4	10	2.2	5.7	3.8–1.2
	11	2.2	6.3	4.3–1.4
	12	1.9	5.7	3.7–0.8
	13	1.6	5.3	2.8–0.6
	14	1.2	4.3	2.9–0.8
	15	1.2	6.3	2.6–0.7
	16	1.4	5.0	3.2–1.0
	17	1.5	4.7	2.7–0.8
5	18	2.0	5.7	3.8–1.0
	19	1.8	5.5	3.1–0.6
	20	2.0	6.0	3.3–1.3
	21	1.7	4.3	4.8–1.0
	22	1.8	3.7	3.5–1.2
	23	2.0	4.7	4.3–1.0
	24	2.3	4.3	3.8–0.9
	25	1.7	4.6	3.2–0.7
6	26	1.6	6.0	3.2–0.6
	27	2.5	5.3	3.7–1.3
	28	2.2	4.3	3.8–0.9
	29	2.3	5.5	3.7–1.3
	30	1.9	4.7	3.7–1.7
	31	2.1	5.0	4.6–1.6
	32	2.0	5.0	3.4–1.1
7	33	1.9	6.0	3.9–1.3
	34	1.5	6.0	3.5–1.0
	35	1.7	5.0	3.7–0.8
	36	2.4	4.7	3.7–0.9
	37	2.4	6.3	4.6–1.0
	38	2.4	4.6	3.6–0.9
	39	1.6	4.3	4.3–1.3
	40	2.5	5.3	4.1–1.7
	41	1.9	5.0	4.1–1.6
H.S.	42	2.3	6.3	5.2–2.4
	43	2.4	5.3	4.1–2.2
	44	1.5	5.3	3.7–0.9
	45	2.5	6.3	4.8–1.8
	46	2.2	6.6	5.4–2.2
	47	1.7	4.0	4.3–1.9
	48	2.4	6.0	4.6–1.7
	49	1.9	5.3	3.7–1.0
	50	3.1	6.6	5.3–2.1
	51	2.8	5.3	4.4–1.6
C	52	2.5	5.6	5.4–1.9
	53	2.7	5.6	4.8–2.2
	54	2.9	5.0	4.5–1.8
	55	2.0	3.0	4.0–2.1
	56	2.5	6.3	4.8–1.7
	57	2.4	4.7	4.9–2.1
	58	2.1	6.6	4.1–1.9
	59	2.5	6.0	5.0–1.3

An interesting point in this connection is that some rapid counters are not the most rapid readers, as is seen in the cases of Nos. 26, 33, and 34. On the other hand, in most cases those who pronounce the list of words rapidly read rapidly, as seen in the records for Nos. 42, 50, and 59, and those who pronounce the words

most slowly, as Nos. 1, 8, and 9, are slow readers. It has already been stated that the list was composed of easy words and, as such, must have been more familiar to the subjects in the upper grades than to those in the lower grades. This indicates that mere familiarity with the language forms influences the rate of reading, as has been suggested in the preceding pages.

Doubtless some of the differences exhibited in the rate of pronouncing words is due to the fact that the vocal reactions of certain subjects are more rapid than those of others, but this would hardly account for the fairly consistent increase which is to be noted as the higher grades are reached. This increase from grade to grade is shown in Table XXXIII. which shows the percentage of subjects having a rate of pronouncing which is two words or more per second.

TABLE XXXIII

INCREASE IN PRONOUNCING RATE ACCORDING TO GRADE

Grade	Percentage of Subjects
3	11
4	25
5	50
6	71
7	44
H.S.	70
C.	100

These results show six different degrees of attainment. The first of these is represented by the third grade: the second, by the fourth grade: the third, by the seventh grade: the fourth, by the fifth grade: the fifth, by the sixth grade and high-school subjects: and the last is represented by the college group. No satisfactory explanation of why the seventh grade is so low can be made. With this exception a consistent increase is to be noted as we ascend the scale. The increase in rate of counting is not great enough to indicate that there has been any large increase in the rate of articulation in the upper grades. It seems evident, therefore, that increasing familiarity with the words is an important factor in producing the result in the pronunciation test.

Table XXXIV shows the facts regarding counting and confirms the general statement made above. This table presents the percentage of subjects in the various grades who have a rate of counting

TABLE XXXIV

COUNTING RATE ACCORDING TO GRADE

Grade	Percentage of Subjects
3	33
4	75
5	37
6	71
7	66
H.S.	90
C	75

of five or more words per second. The absence of any uniformity in these results indicates that difference in rates of counting is a matter of individual rates of reaction and not subject to change through training. In counting there is a tendency to slur over words. This fact may contribute to certain of the differences in the table. Indeed, the counting test seems to show the physiological limit for rate of articulation. The impressive fact in that column of Table XXXII is its uniformity rather than its variations.

In the reading test the two factors of rate of mere articulation and rate due to familiarity with the words are of course both included. Later investigations will return to the analysis here suggested.

VOCALIZATION DURING SILENT READING

While each subject was taking the silent-reading tests a note was made of the amount of vocalization. Four degrees of vocalization are recorded in Table XXXV as follows: very much, three asterisks; much, two asterisks; little, one asterisk; none perceptible, zero.

The following points are apparent in connection with this table:

1. The greatest amount of vocalization occurs in the third and fourth grades.

2. Those who are given either two or three asterisks do not read with a rate which exceeds 5.9. In the group of fourteen subjects who are given two or three asterisks, only three have a

rate above 4.0; therefore in a large majority of cases a high degree of vocalization is related to slow reading.

TABLE XXXV

AMOUNT OF VOCALIZATION SHOWN BY EACH SUBJECT IN SILENT READING

Grade	Subject	Amount of Vocalization	Range in Silent Rate	Grade	Subject	Amount of Vocalization	Range in Silent Rate
3....	1	**	3.1–1.3	7.....	33	*	4.1–2.5
	2	o	4.5–2.5		34	o	3.4–1.3
	3	**	3.6–2.1		35	o	3.0–1.9
	4	**	4.1–2.2		36	*	3.4–1.9
	5	**	1.9–1.5		37	*	4.1–1.6
	6	o	3.3–1.9		38	**	5.9–2.0
	7	*	5.8–2.5		39	o	5.9–2.8
	8	**	1.9–0.8		40	*	4.6–2.4
	9	***	2.5–1.9		41	*	3.5–2.1
4....	10	**	3.1–1.7	H.S..	42	o	4.9–2.5
	11	**	2.7–1.6		43	o	6.5–3.5
	12	*	3.0–1.6		44	*	4.7–2.0
	13	*	2.4–1.3		45	*	3.9–2.6
	14	**	3.4–1.5		46	*	4.6–1.9
	15	*	2.2–1.0		47	o	6.5–3.3
	16	**	2.9–0.9		48	o	4.1–1.8
	17	**	2.0–1.2		49	o	3.1–1.4
5....	18	*	3.1–1.7		50	*	5.1–2.1
	19	*	2.9–1.2		51	o	4.6–2.1
	20	o	3.1–1.2	C....	52	*	8.2–3.8
	21	*	3.5–1.5		53	o	8.2–3.1
	22	o	2.3–0.8		54	o	8.2–3.4
	23	*	3.8–1.4		55	o	4.1–2.4
	24	*	4.1–2.1		56	*	6.8–3.3
	25	o	3.0–1.2		57	o	10.0–3.6
6....	26	o	2.9–0.8		58	*	6.8–3.1
	27	*	5.3–1.8		59	o	6.0–2.8
	28	**	3.7–1.3				
	29	**	4.1–2.1				
	30	*	6.0–4.3				
	31	*	5.6–2.5				
	32	o	4.6–1.6				

3. In the third, fourth, fifth, and sixth grades the most rapid reader is marked with one asterisk, while in the seventh grade, as well as in the high-school and college groups, the most rapid readers are marked without perceptible vocalization.

4. Evidently some other factor than vocalization retards the reading of subjects Nos. 22 and 26, whose rates are below 3.0, and No. 55, whose rate is 4.0.

The conclusions to be reached here are as follows:

a) A large amount of vocalization appears in connection with slow reading.

b) Rapid reading is possible with a slight degree of vocalization.

c) The absence of vocalization is not the only factor which makes for fast reading.

BREATHING IN RELATION TO ORAL READING

In order to secure data on the relation of oral reading to the act of respiration, pneumographic records were taken while the subject was reading aloud. A modification of the Verdun pneumograph was used. In Fig. 1 the recording end of the ordinary form of this instrument is shown by the continuous lines, while the author's addition to it is indicated by the dotted lines. The plate *A* keeps the pneumograph from turning up or down, while the lever *B* always allows an outward pull on the rubber membrane at *C*. This lever is very essential because in the case of children who have a small chest the pull in the ordinary form of the apparatus is likely to be almost parallel with the surface of the rubber membrane, that is, in the direction of the point *C*. In such cases the pull on the rubber may be considerable, yet the change in volume will be very slight, and the record taken is not a true representation of the breathing movements.

The records were always taken with the pneumographs over the clothing, except that the boys were asked to remove their coats. One pneumograph was placed over the lower thorax, and the other at about the fourth or fifth rib. The pneumographs were connected with tambours, the markers of which traced the record on kymograph paper. The subject read into a dictaphone. A revolving cam on the dictaphone operated an electric marker at regular intervals. The movements of this marker were registered alongside the pneumograph records. Synchronous with this marker a solenoid sounded a bell, which was recorded on the wax cylinder of the dictaphone. This made it possible to tell what words in the oral record corresponded to certain points on the breathing curves.

After the apparatus was adjusted the subject was allowed to sit quietly for a short time until the normal-breathing curve was

recorded. The signal to begin reading was then given and the exact point of beginning was indicated on the record. The place on the record where the reading ended was also marked, and the subject was allowed to sit quietly until breathing became normal.

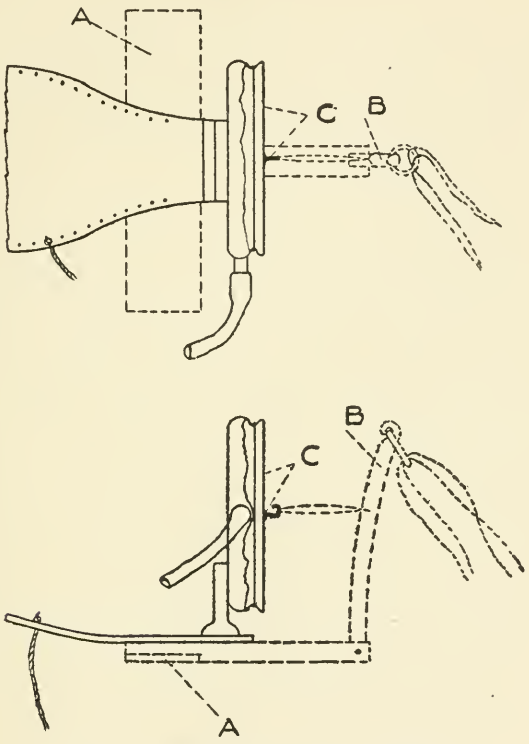


FIG. 1.—Modified Verdun pneumograph
A—Plate to hold pneumograph in position
B—Lever
C—Rubber membrane

The records were taken on a kymograph with an extension. This gave a record two meters in length and allowed a much larger body of material to be read than with the ordinary form of kymograph. A time line recording fifths of a second was made by means of a Jacquet chronometer. Three selections varying in difficulty were read.

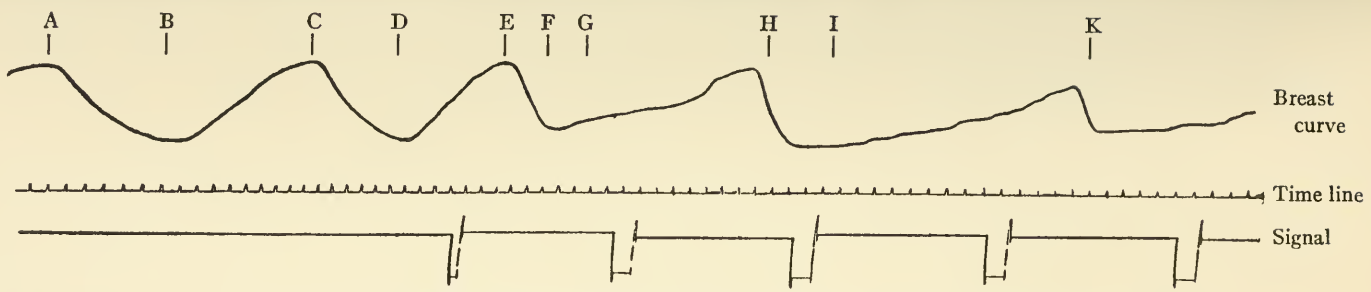
Plates I, II, III, and IV show typical breathing curves. Plate I shows a breast curve, the time line, and the signal, the first part of the record being the normal-breathing curve, with the length of inspiration represented by the distances *AB* and *CD*. The signal to read is given at *E*. It will be noted that the expiration is completed in the normal way, but the inspiration following it (*FG*) is very much shorter. Inspirations at *H* and *K* are quick and the breath is expired very slowly. The effect of oral reading is to reduce in a very considerable degree the length of inspiration and to increase the length of expiration, as indicated by the distances *GH* and *IK*.

Plate II shows both the breast curve and the abdominal curve and the time line. The two breathing curves are so much alike that they might be interchanged. Inspiration takes place in the relatively short time in which the pneumographic pointer moves from *A* to *B*, *C* to *D*, etc. In this particular record inspiration time scarcely exceeds three-fifths of a second at any point. Expiration is a gradual process and takes place while the pointer moves from *B* to *C*, from *D* to *E*, etc.

Plate III shows two breathing curves. It is true that there is regularity, but there is a marked difference between the forms of the breast and abdominal curves. The abdominal curve is much like those shown in Plate II, while the breast curve is entirely different. Instead of showing a gradual expiration or an upward movement of the curve during the reading pause, as in Plate II, there seems to be little expiration during the reading. Then comes a sudden expiration, followed by a quick inspiration. This type of breathing is controlled to a large extent by the diaphragm, and the training given by some teachers of vocal music and public speaking is said to result in this type of reaction.

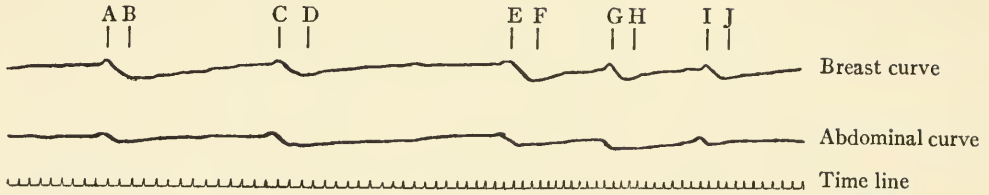
Plate IV is of the same type as Plate I. It shows a record in which, however, the movement in the breast curve is much greater than that in the abdominal curve. In many other cases, which cannot be reproduced in full, the movement is as great as, or greater than, that shown here. There is little if any correspondence in Plate IV between the two curves, no trace of regularity in the abdominal curve, and very marked regularity in the breast curve.

PLATE I



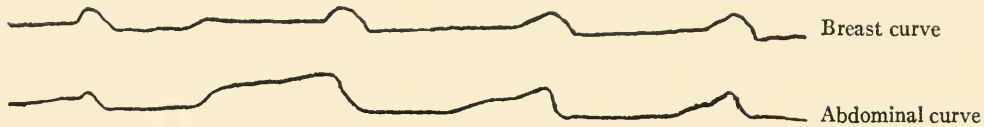
DIFFERENCES BETWEEN NORMAL BREATHING CURVES AND BREATHING CURVES DURING ORAL READING

PLATE II



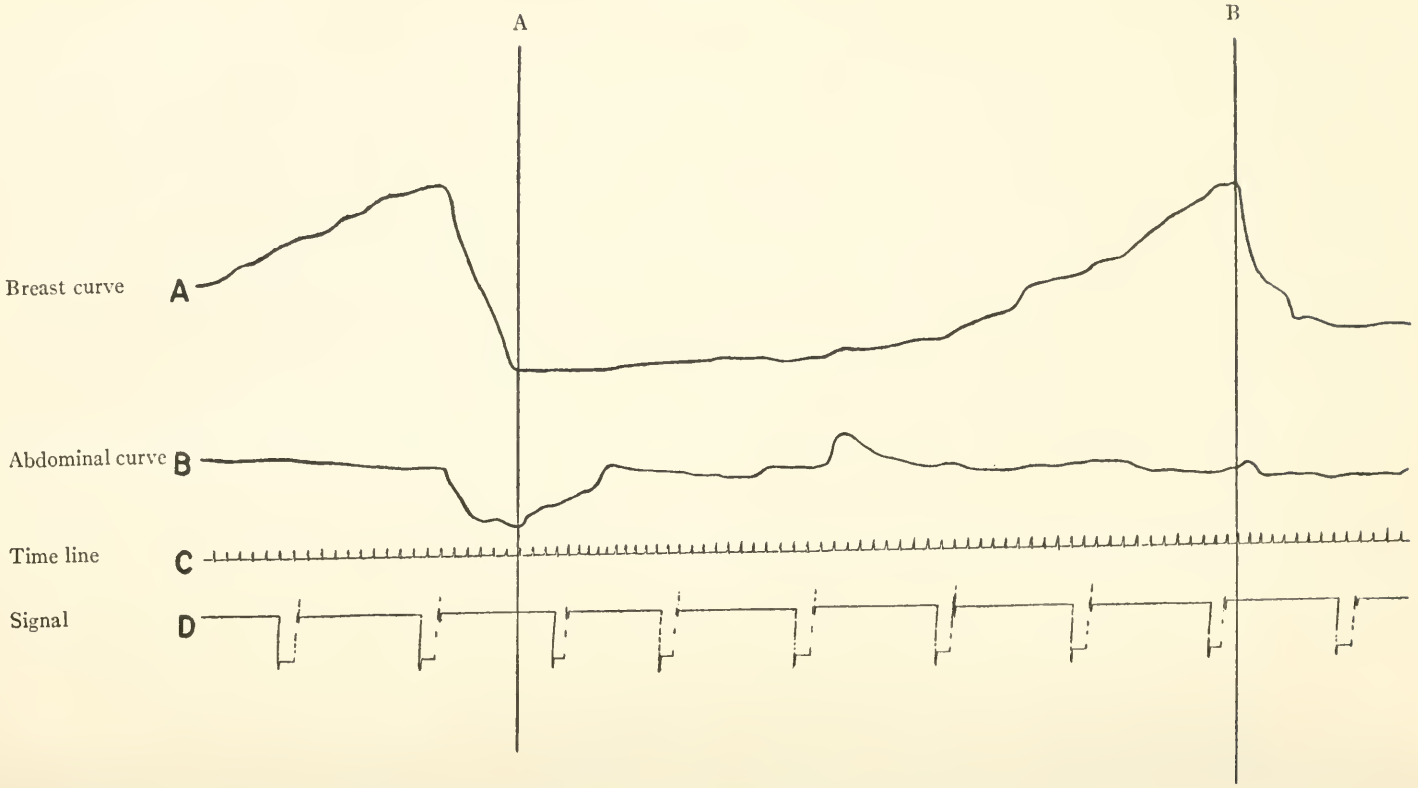
BREATHING CURVE FOR SIXTH-GRADE BOY DURING READING

PLATE III



CURVE RESULTING FROM ABDOMINAL BREATHING

PLATE IV



DIFFERENCES BETWEEN BREAST AND ABDOMINAL CURVES FOR SIXTH-GRADE BOY

The length of the expiration in the breast curve extends over a period of eleven and three-fifths seconds, a length which is not at all infrequent.

Plate V shows the record of a seventh-grade boy. The electric marker, which made the third record from the top in this plate, was operating synchronous with a bell, the sound of which was registered on the wax cylinder of a dictaphone. The vertical lines 1, 2, 3, etc., marked across the record, indicate the points at which the stroke of the bell sounded. The selection read is reproduced herewith—selection 5 (p. 77). On this are marked with numbers the points corresponding to the points 1, 2, 3, etc., in Plate V.

In taking the vocal records off the cylinders it is impossible to get the exact location of the sound. The difficulty arises from the fact that the individual who is taking the record has to listen to two things—the sound of the bell and the vocal sounds recorded. There results a fluctuation of attention, which makes it impossible to get the exact location of the sound of the bell. It is possible, however, to tell whether the bell comes before, after, or within, a short word, and whether it falls within the first or last part of a long word. The passage is also marked with lettered lines. These show where the reader paused in his oral reading. These pauses were pauses for emphasis and will be discussed more fully later.

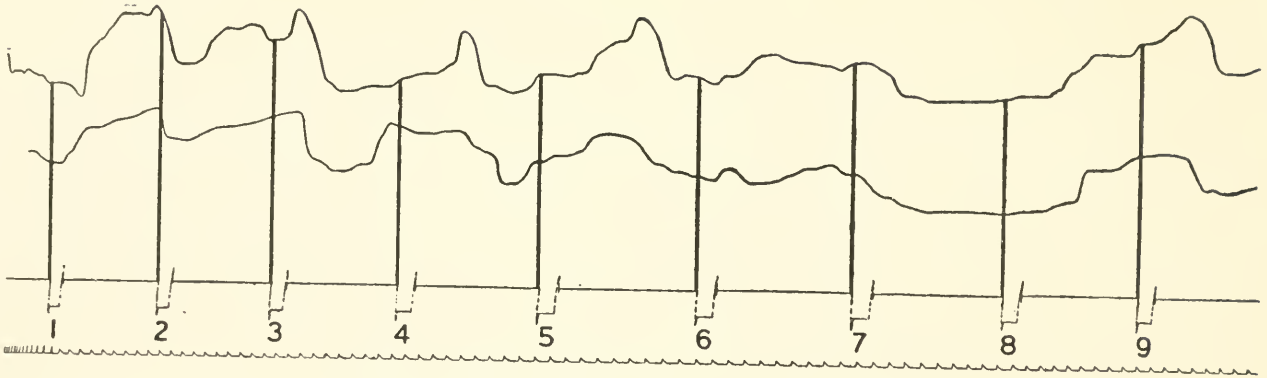
Plate VI gives the record for a sixth-grade boy, while Plate VII shows the record of a seventh-grade boy. The corresponding reading material is reproduced in selections 6 and 7, respectively (pp. 77, 79). The words in parentheses are either insertions or repetitions made by the reader.

In the case recorded in Plate VII the reading was poor, and the phonograph record contained a large number of hesitations, many of which broke the continuity of the reading. It is impossible in this record to tell which are sense pauses and which are merely hesitations.

If the sense pauses in the selection which accompanies Plate V are studied in detail, it is seen that pauses *b*, *d*, *f*, and *h* seem to coincide with breathing pauses, but the others do not.

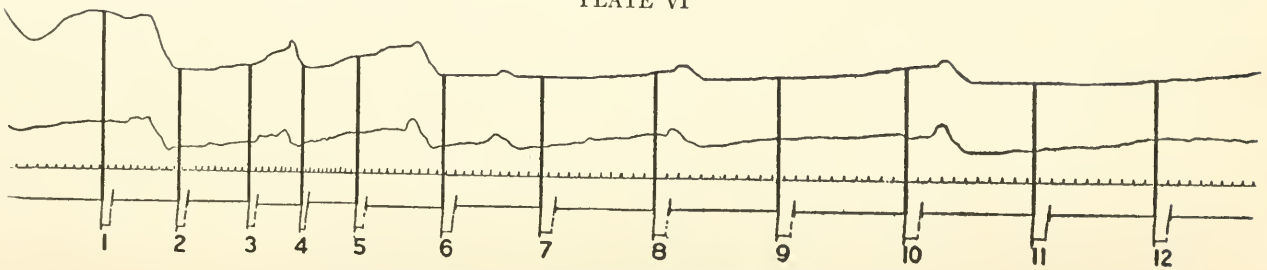
If Plates VI and VII are studied, there is revealed the same accidental or only partial relation between the breathing and sense

PLATE V



Breathing Curve for Seventh-Grade Boy during Reading

PLATE VI



Breathing Curve for Sixth-Grade Boy during Reading

pauses. These facts make it evident that articulation and oral emphasis are two independent processes. Respiration, which is a part of the physiological process of articulation, often goes on without modification, while the demands of emphasis are being met

SELECTION 5.—BREATHING

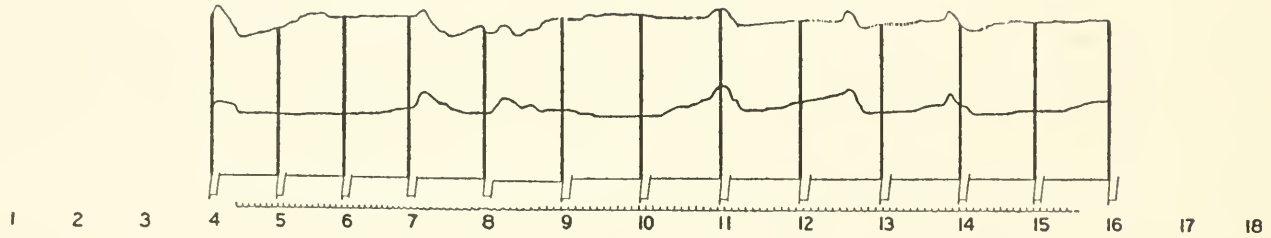
This one was evidently very old, for
it had been weathered and wasted until it
was the most dangerous and inaccessible that
ever lay in my way. The width of the cre-
vasse was here about fifty feet, /and / the
silver crossing diagonally// was about (twenty)
seventy feet long;/its thin knife-edge/near
the middle/was depressed/ twenty-five or
thirty feet//below the level of the glacier,/
and the upcurving ends were attached/to the
sides eight or/ ten feet below the brink./

SELECTION 6.—BREATHING

This one was evidently very old,/ for it had
been weathered/ and wasted/ until it was the
most dangerous/ and inaccessible/that ever lay
in my way./ The width of the crevasse was here
about fifty feet,//and the silver crossing
diagonally was about seventy feet long;// its
thin knife-edge/ near the middle was depressed
twenty-five or thirty feet below the level of
the glacier./

through pauses dictated by the sense of the passage rather than by respiration. In the long run respiration has to be controlled in the interests of interpretation rather than the reverse, but evidently the control is not complete.

PLATE VII



BREATHING CURVE FOR SEVENTH-GRADE BOY DURING READING

Table XXXVI gives in the case of fourteen subjects the length of time which elapses from the end of one expiration to the end of the next. To secure these facts perpendiculars are dropped from the breathing records to the time line, care being taken to start the perpendicular at the highest point of the curve. In the case of subject No. 1 nineteen-fifths seconds elapsed between the end of the first expiration and the end of the second, eight-fifths seconds between the ends of the second and third expiration,

SELECTION 7.—BREATHING

This / one was evidently very old //, for it had been weathered/ and wasted until it was the most dangerous/ and inaccessible/ that// ever lay in my way.// The width of the crevasse was here about fifty feet//, and the silver crossing// (diag silver crossing) diagonally was about/ seventy feet long// its thin knife-edge/ near the middle was depressed twenty-five or thirty feet below the level// of the glacier// and the upcurving ends were/ attached/ to the/ sides/ eight or ten feet// below the brink/. Getting down/ the nearly vertical/ wall. . . . .

and so on. The large individual variations, as well as the large variations within the records of single individuals, show that articulation and interpretative emphasis are playing havoc with a physiological process which is ordinarily very regular. The sudden changes in respiration revealed in this table show how constant is the influence of the mental process of interpretation on the physiological process of respiration.

Table XXXVII gives further qualitative data concerning the curves for all subjects. No abdominal records were taken for the high-school or college girls. In a few cases the apparatus failed to work properly for one of the curves. These explanations account

for the blanks in the table. The degree to which the records showed correspondence between abdominal and breast curves, deep breathing, regularity of the breast curve, and regularity of the abdominal curve was estimated by the experimenter and has been indicated in the table by three asterisks for a large degree, two asterisks for a medium degree, and one asterisk for a very slight degree.

TABLE XXXVI

LENGTH OF BREATHING PERIODS DURING READING

Grade	Subject	Breathing Periods						Average
		1	2	3	4	5	6	
3.....	1	19	8	11	17	14	25	15.7
	7	15	15	20	15	13	14	15.3
4.....	12	24	13	17	20	26	12	18.7
	15	9	7	13	9	9	6	8.8
5.....	18	14	13	16	9	15	15	13.7
	24	19	14	18	17	14	13	15.8
6.....	28	19	14	12	13	12	5	12.5
	30	26	16	31	10	11	31	20.8
7.....	33	15	23	28	21	19	27	22.2
	37	22	15	24	16	6	10	15.5
H.S....	42	33	22	20	8	9	18	18.3
	51	20	24	14	14	18	17	17.8
C.....	54	12	21	9	15	18	29	17.3
	56	36	36	12	16	18	28	24.3

In nineteen of the twenty-six cases listed the breast curve has greater movement than the abdominal curve. Of the nineteen cases, eight were girls and eleven boys. Correspondence between the two curves is not shown in a marked degree except in five cases.

Depth of breathing increases with progress through the grades, though somewhat irregularly. The fourth grade seems to have less depth of breathing than any other grade, while the high-school group does not show as great depth as either the seventh grade or the college group. There is a decided increase in the regularity of the breast curve in the high-school and college groups. Marked regularity in the abdominal curve is shown in only four cases.

TABLE XXXVII

DATA CONCERNING BREATHING CURVES FOR ALL SUBJECTS

Grade	Subject	Greater Movement	Correspondence between Abdominal and Breast Curves	Depth of Breathing	Regularity of Breast Curve	Regularity of Abdominal Curve
	1	.....	***	**	**	**
	2	.....	.....	*	*	.....
	3	.....	*	*	*	*
	4	.....	.....	**	.....	**
3	5	.....	.....	**	*	.....
	6	.....	***	**	**	**
	7	Br.†	*	**	*	*
	8	.....	*	*	*	*
	9	.....	.....	**	*	.....
	10	Br.	*	*	*	*
	11	.....	**	*	*	*
	12	Ab.‡	**	*	*	*
4	13	Br.	*	*	*	*
	14	Br.	***	*	*	*
	15	Br.	*	*	*	*
	16	.....	*	*	*	*
	17	.....	***	*	***	***
	18	Br.	.....	*	*	.....
	19	Br.	*	**	*	*
	20	Br.	*	*	.....	*
5	21	Br.	.....	*	*	.....
	22	Ab.	*	**	*	*
	23	Br.	*	*	*	*
	24	Br.	*	*	*	*
	25	Br.	*	*	**	*
	26	Ab.	*	*	*	*
	27	Br.	*	*	*	*
	28	Br.	*	**	*	*
6	29	Ab.	*	*	*	*
	30	.....	***	**	***	***
	31	Br.	*	**	*	*
	32	Br.	*	**	**	*
	33	.....	**	**	*	*
	34	Br.	*	**	*	*
	35	.....	.....	**	*	.....
	36	Ab.	*	**	***	***
7	37	Br.	*	*	*	*
	38	.....	.....	**	*	.....
	39	.....	.....	***	.....	*
	40	.....	**	***	*	*
	41	.....	*	***	*	*
	42	.....	.....	**	***	.....
	43	Ab.	*	**	***	***
	44	.....	.....	**	***	.....
	45	.....	.....	*	**	.....
H.S.	46	.....	.....	**	***	.....
	47	.....	*	*	*	*
	48	.....	.....	*	*	.....
	49	Ab.	*	**	*	*
	50	.....	.....	**	*	.....
	51	Br.	*	*	*	*

TABLE XXXVII—*Continued*

Grade	Subject	Greater Movement	Correspondence between Abdominal and Breast Curves	Deep Breathing	Regularity of Breast Curve	Regularity of Abdominal Curve
C.....	52	.....	.....	***	***	.....
	53	.....	.....	***	***	.....
	54	.....	.....	***	**	.....
	55	.....	.....	**	*	.....
	56	.....	.....	**	***	.....
	57	.....	.....	**	***	.....
	58	.....	.....	***	***	.....
	59	.....	.....	**	***	.....

† Br. = breast curve.

‡ Ab. = abdominal curve.

No clear parallelism could be traced between the different qualities of oral reading and the breathing co-ordinations. The curve in Plate II, which is the record of a very good reader (No. 30 in Table XXXVII), shows great regularity and little depth. The curve in Plate III, which is the record of a poor reader (No. 36 in Table XXXVII), shows great regularity and slightly greater depth of breathing than is shown in Plate II. The curve in Plate IV was made by a poor reader (No. 29). In this record the lack of correspondence between the abdominal and breast curves is very striking, and yet there is exhibited in the breast curve marked depth of breathing and length of the expiration period. Plate V is a record of a good reader (No. 41), while Plates VI and VII were produced by medium readers (Nos. 28 and 33).

Individual variations are more conspicuous than any regular relationship between respiration and reading ability. It is possible to trace in a loose general way some parallelism between regularity in breathing and good reading. Apparently the individual who has good muscular co-ordinations has also superior ability in reading. But such a parallelism is only very vaguely shown by the records.

The conclusion to which we are led is that breathing is very little considered in ordinary school training. As a result the accidents of individual experience control.

A very interesting problem for further work could be found in experimental training in breathing as a part of a course in oral

reading. Many teachers of public speaking emphasize the matter of breathing, but there are no records from the pupils of these teachers to compare with the records presented above.

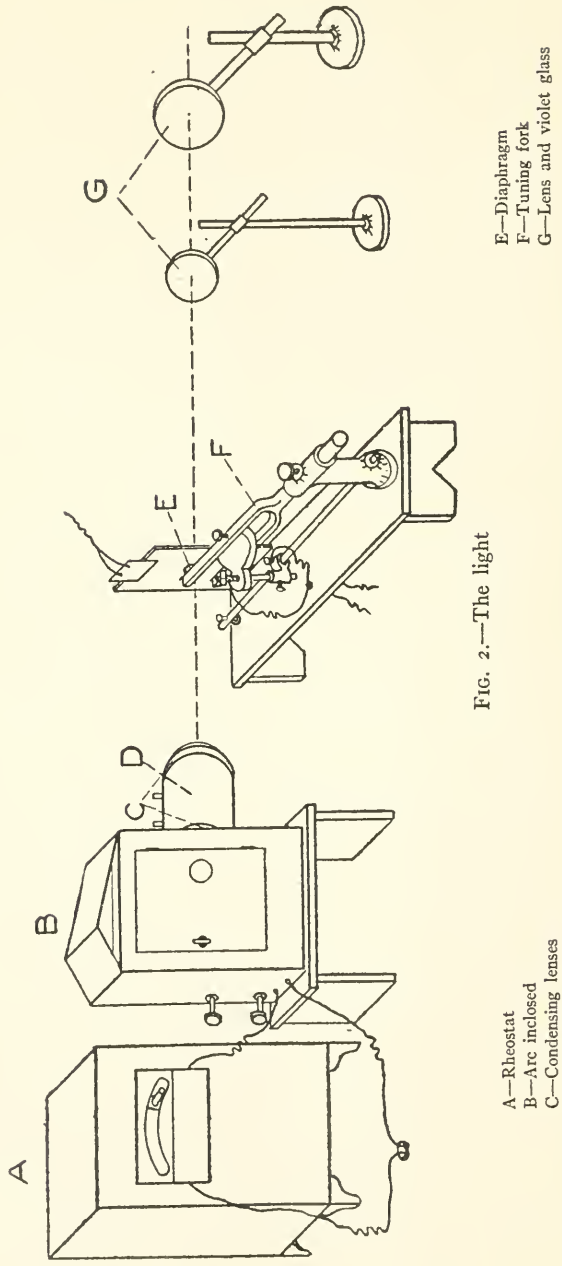
EYE-MOVEMENTS

APPARATUS

The apparatus used for the experiments with eye-movements was a modified form of the photographic apparatus used by Dodge and by Dearborn. It consists essentially of four parts: an arc light, from which is derived the ray of light to be photographed; a headrest, to keep the subject in position; the camera; and the mechanism for moving the film on which the record is taken.

The light.—The source of light was an ordinary arc with an adjustable rheostat attached, so that from 15 to 25 amperes of current could be used. The light from this arc was passed through a double convex lens and cooling tank and was focused on a small hole in a diaphragm which cut off all marginal light. A fifty-vibration tuning fork was so placed between the lamp and diaphragm that one of the prongs vibrated through the path of the light and cut it off fifty times a second. This device has the advantage of turning the photograph into a time record. Beyond the diaphragm, as the light was diverging, it was passed through a double convex lens, placed at focal distance from the diaphragm. This lens directed the light into a series of parallel rays. A plate of violet glass, placed in the path of the parallel rays, reduced the intensity of the light falling on the eyes, until it was not noticed in most cases by the reader. The light then passed to two small mirrors just in front of the subject, was reflected into the subject's eyes, and from the eyes was reflected into the lenses of the camera. Fig. 2 shows the different parts of the apparatus just described.

The headrest.—The headrest is necessary to hold the head in position while the photograph is being taken. Since most of the subjects were children, it was thought best not to use the mouth-piece described by Dearborn, but rather to clamp the head above the eyes as firmly as possible. This was done by means of a band which encircled the head with four points of contact—one on the



A—Rheostat
B—Arc inclosed
C—Condensing lenses
D—Cooling tank

E—Diaphragm
F—Tuning fork
G—Lens and violet glass

FIG. 2.—The light

forehead, two on the temples, and one at the back. In addition to this the cheek bones were brought into contact with supports. While these six points of contact did not eliminate all movements of the head, the complications from head-movement were much reduced. Furthermore, from check photographs it was possible to recognize head-movements. The check photographs were made by photographing the light reflected from a polished bead set in spec-

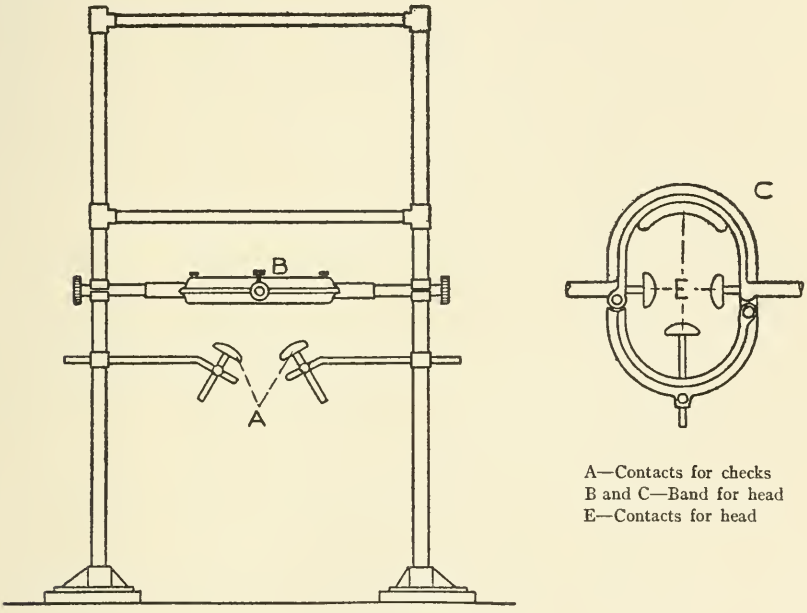


FIG. 3.—The headrest

tacle frames and worn by the subject. The headrest is shown in Fig. 3.

The camera.—This was constructed so that simultaneous photographs could be taken from the two eyes. The lenses used are Goerz-Syntor, 12-inch focus. The mounting was necessarily complicated, in order that the focus might be accommodated to each individual subject. One adjustment was provided so that the two lenses could be separated or brought near together. A second adjustment allowed the left lens to move independently in a vertical direction. A third and fourth adjustment allowed the camera as

a whole to be moved horizontally or vertically. A fifth and sixth adjustment permitted the lenses to be focused by independent movements forward or backward or by a movement of the film-holder. All of these adjustments could be made from the back by the operator by means of rods and screws. The body of the camera was made of a brass tube, eight inches in diameter and four feet in length. At the back end of this was placed the usual camera bellows, which allowed adjustments. Since the records were all taken in a light room, a focusing bellows was provided back of the film-holder. Fig. 4 shows the camera.

The moving film.—The film used is the twelve-exposure Eastman Kodak film. The length is about 1.2 meters. The mechanism for carrying the film is shown in Fig. 5. The apparatus was so constructed that two films could be set in motion at the same time, one moving vertically, the other moving horizontally, or a single film could be used. In general only the vertically moving film was used. If the vertical film alone is used, it unrolls from the spool *C* to a spool carried between *D* and *E*. The driving power is applied to the rod *D* by a motor (not shown in the figure). The exposure of the film during its movement is made as it passes the area *A*, where the image falls from the lenses.

When a horizontal film is used, it unrolls from a spool at *G* to a spool at *F*. The spool at *F* is moved by the rod *D* through the gear shown in the figure. Exposure of the two films at the same time can be made by focusing one point, that to be photographed on the horizontal film in the area *B*, while the point to be photographed on the vertically moving film is focused in *A*.

The rod *D* was driven by an electric motor. This motor was started at the beginning of the experiment, and the rod *D* was connected with the motor at any time which the experimenter chose by means of an electric clutch.

THE EXPOSURE APPARATUS

In order to control readily the reading matter, it was projected from a lantern hung on a separate holder above the camera. The image was reflected from a silvered surface to a plaster-of-Paris surface just below the lenses of the camera. The subject could here

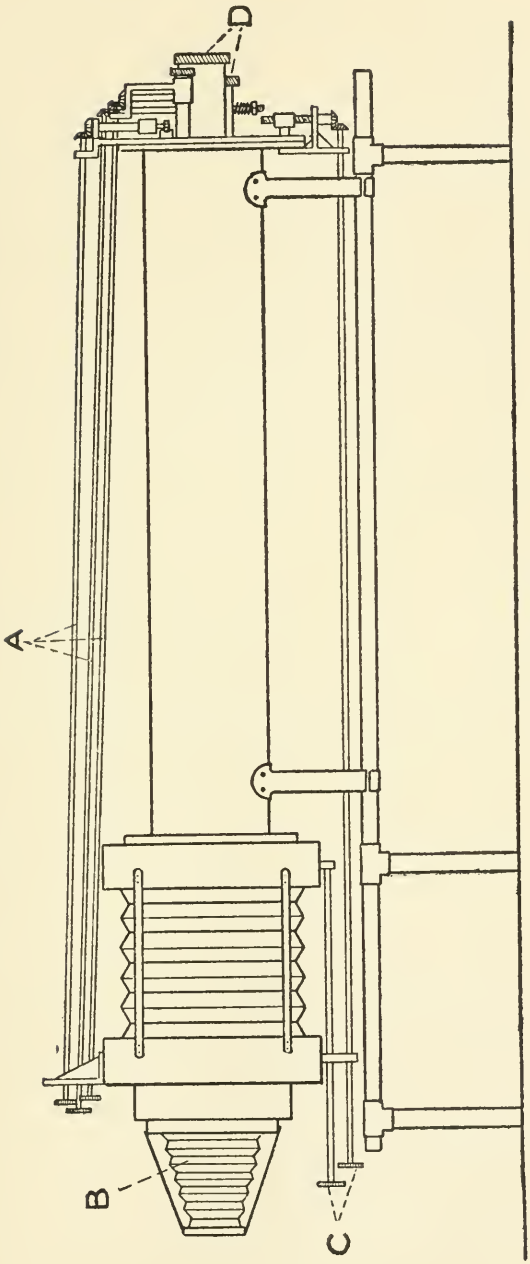


FIG. 4.—The camera

A and C—Rods for adjustments
B—Focusing bellows
D—Lenses

read it readily, while the operator could control its appearance and disappearance as well as its size through the projection lantern. Fig. 6 shows this apparatus.

All selections to be read were photographed and made into lantern slides. Each slide was made, furthermore, with a point outside of the reading matter which the reader was required to fixate in order to facilitate interpretation of the photographs of eye-movements, when these had to be related to the reading matter, by methods to be described later.

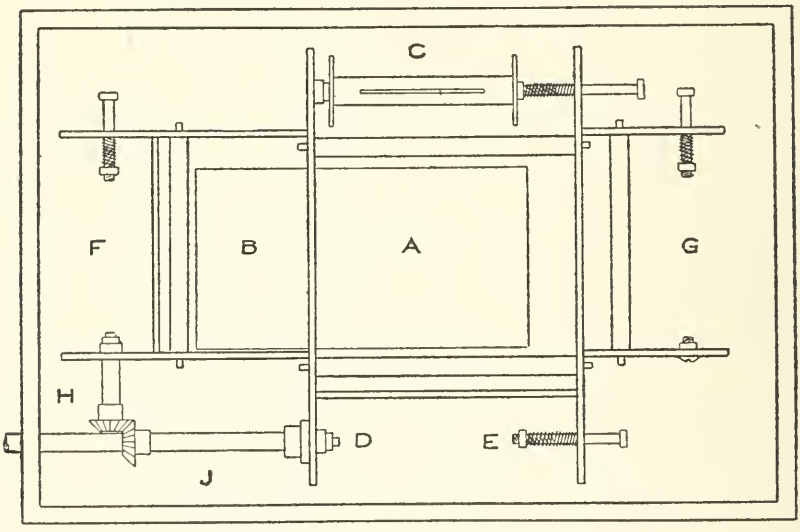


FIG. 5.—Mechanism for moving films

In taking the photographs the subject was seated before the apparatus in a chair which could be adjusted as to height. When a correct position had been assumed, a trial selection was thrown upon the plaster-of-Paris surface, and the subject was informed just how the dots were to be fixated. Since it was found that merely telling the subject what to do was not sufficient in many cases, some preliminary practice was given in the fixation of the dots and in starting the reading. Sometimes several trials were necessary before the experiment proceeded. When this preliminary part was over, the head was clamped firmly in the headrest and the

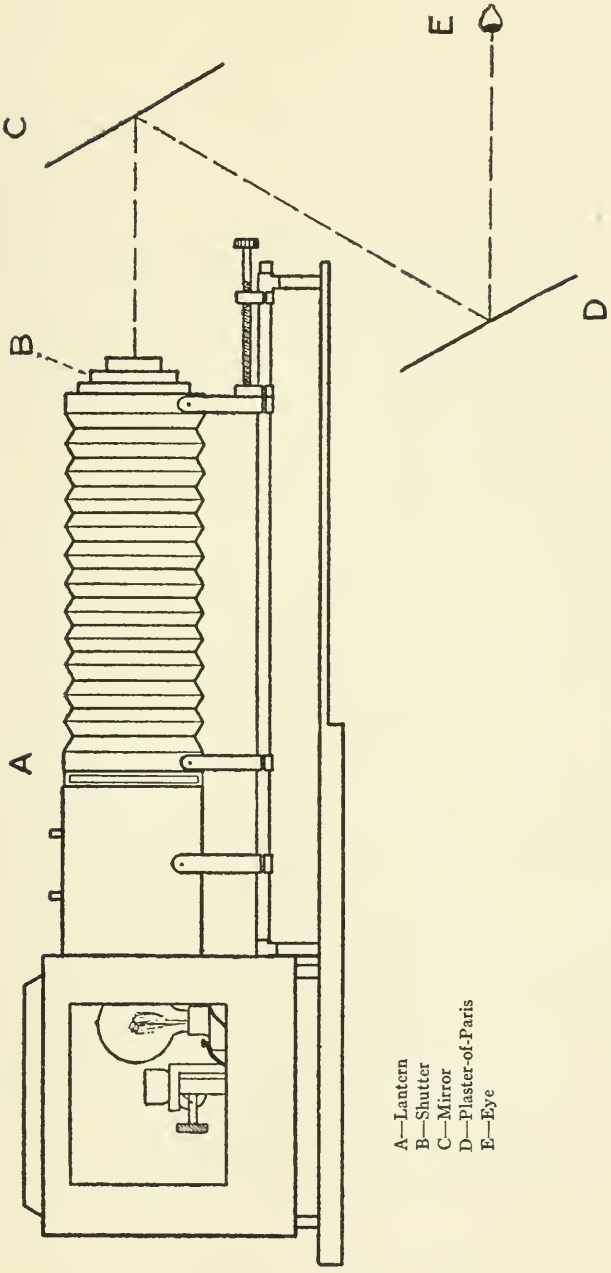


FIG. 6.—Apparatus for exposing reading material

light was thrown on the eyes. The subject was asked whether any discomfort was felt from the light. In only two cases was any complaint made, and each of these children was dismissed immediately. The light from the eyes was focused next on the ground glass in the back part of the camera. The subject closed his eyes while the film was adjusted, and the selection to be read was placed in the projector. As soon as all was in readiness the subject was told to open his eyes and proceed with the reading. While the process is complicated, yet in most cases a record could be taken in three minutes or less.

In many cases, when the reading was over the child was questioned to see whether the selection had been understood, and in most cases the results indicated that it had been.

The question may arise as to the attitude which the children took toward the experiments involving the use of apparatus and as to the extent to which the artificial conditions of the experiment affected their reading. The children of this particular school are called on to act as subjects in so many types of experiments throughout the year that they become accustomed to such work. In addition, however, precautions were taken to prepare them for the photographs. A part of the apparatus was in full view when they came into the laboratory for the first oral- and silent-reading tests. This led to questions as to the purpose "of all those fixings." They were told about the photographs and always took an interest. In a few cases, where a little nervousness was shown, the children were allowed to read three selections instead of two, and no record was taken of the first reading.

UNSATISFACTORY RECORDS

Satisfactory records could not be obtained from a few of the subjects whose eyes did not seem to reflect the light in a sufficient quantity to affect the film, while in other cases, in spite of all precautions, head-movements were so great that the records had to be discarded. It is rather interesting that those whose records were discarded on account of head-movements were in every case poor readers.

Some of the records are shown in Plates VIII and IX. A very clear record is *C* in Plate VIII. This record, it will be noted, is

EYE-MOVEMENT RECORDS

A and B, the record of a poor reader (B. R.) in the sixth grade; C, a good reader in the same grade; D shows loop made by eye in focusing dots before reading begins. The straight line in this record is made by the bead. E shows binocular record of an adult reading poetry for the purpose of answering questions upon it.

PLATE IX

EYE-MOVEMENT RECORDS

made up of a series of dots. As explained in describing the apparatus, the light is interrupted every fiftieth part of a second by a tuning fork, hence the dots. The photograph shows two kinds of lines—first, short vertical lines; secondly, horizontal lines. The vertical stretches mean fixations of the eye. Since the film is moving vertically downward, the pencil of light will trace a vertical line so long as the eye is fixated in a single position. As soon as the eye moves to the right or the left, the pencil of light will trace a horizontal line. The direction of the eye-movement is indicated by the direction of the horizontal line away from the vertical. The short horizontal movements show how the eye moves across a line of printed matter in short steps. The long sweep back to the beginning of the next line is easily distinguished from the short movements. In some cases there is a short backward movement within the line. Such short movements will be called regressive movements.

The first part of the study of these records consists in determining the total number of pauses for each line, the length of the pauses in fiftieths of a second, and their average variation. In addition to this, the number of regressive movements for each line, together with their length and average variation, must also be determined.

Table XXXVIII gives the average number of pauses per line, the average length of the pauses, the average of the mean variations, etc., for all subjects for whom satisfactory records were procured. The last column is taken from the silent-reading rates, Table XI, page 37.

In connection with these data the following points may be made:

1. Those who make nine or more pauses do not have a rate which exceeds 3.8 words per second. This evidently means that, when the number of pauses is nine or more, perception takes place in small units and rapid reading is impossible.

2. If the subjects whose average number of pauses per line is between 7.0 and 8.9 are canvassed, it will be seen that their rates vary from 2.4 to 1.3 for subject No. 13 to 8.2 to 3.1 for subject No. 53. In other words, with this number of fixations there may be variations in the gross rate depending on factors other than the number of pauses.

TABLE XXXVIII

DATA CONCERNING EYE-MOVEMENT RECORDS IN SILENT READING

Grade	Subject	Average No. of Pauses per Line	Average Length of Pauses	Average Variation for Length of Pauses	Average No. of Regressive Movements	Average Length of Regressive Movements	Average Variation for Length of Regressive Movements	Silent-Reading Rate
3	1	13.8	18.2	6.9	4.1	19.6	6.2	3.1–1.3
	2	7.9	13.5	3.6	2.0	14.6	2.8	4.5–2.5
	3	9.2	12.9	4.0	4.0	13.3	3.9	3.6–2.1
	4	6.2	12.8	2.1	0.3	3.7	0.0	4.1–2.2
	6	7.3	15.6	5.2	1.0	8.5	0.5	3.3–1.9
	7	7.1	11.8	2.2	1.3	12.2	0.2	5.8–2.5
	8	14.0	15.6	4.2	3.0	16.6	1.1	1.9–0.8
	9	14.5	13.1	4.8	3.5	11.0	3.5	2.5–1.9
Average		10.0	14.2	4.1	2.4	12.4	2.3	.....
4	10	6.7	10.9	2.3	0.9	5.9	0.3	3.1–1.7
	11	5.6	10.5	2.7	1.2	9.5	1.0	2.7–1.6
	12	11.0	.....	.....	4.5	.....	.....	3.0–1.6
	13	7.4	.....	.....	1.6	.....	.....	2.4–1.3
	15	12.3	16.9	3.7	3.0	15.2	2.5	2.2–1.0
	17	11.5	11.9	2.9	1.5	15.5	1.5	2.0–1.2
Average		9.1	12.5	2.9	2.1	11.5	1.3	.....
5	18	9.0	14.7	4.3	1.0	8.6	0.3	3.1–1.7
	19	10.7	11.3	3.3	3.2	12.8	4.3	2.9–1.2
	21	7.0	14.5	4.2	1.0	11.1	0.4	3.5–1.5
	22	13.0	.....	.....	4.3	.....	.....	2.3–0.8
	23	10.3	12.6	2.9	1.0	15.3	0.0	3.8–1.4
	24	7.0	16.0	3.1	2.0	12.5	0.5	4.1–2.1
	25	13.0	.....	.....	4.5	.....	.....	3.0–1.2
Average		10.0	13.8	3.5	2.4	12.0	1.1	.....
6	26	15.5	15.4	5.7	4.5	13.4	3.4	2.9–0.8
	27	4.0	12.2	3.2	0.0	.....	.....	5.3–1.8
	28	9.3	13.9	3.4	1.7	15.6	1.7	3.7–1.3
	29	6.3	12.1	2.4	1.1	9.1	0.5	4.1–2.1
	30	5.8	11.2	2.1	0.5	3.9	0.2	6.0–4.3
	31	4.6	11.0	2.7	1.0	10.3	0.2	5.6–2.5
	32	7.5	11.5	2.0	1.0	6.8	1.8	4.6–1.6
Average		7.5	12.5	3.1	1.4	9.8	1.3	.....
7	33	7.0	.....	.....	2.0	.....	.....	4.1–2.5
	34	10.5	15.3	4.3	2.0	13.3	1.2	3.4–1.3
	35	9.3	14.4	4.7	2.0	17.7	1.5	3.0–1.9
	36	10.7	11.4	3.5	3.2	11.0	2.2	3.4–1.9
	37	8.2	13.5	3.4	0.7	4.4	0.1	4.1–1.6
	38	8.1	13.1	3.3	2.0	10.4	0.6	5.9–2.0
	39	7.0	12.9	3.5	1.0	9.5	0.8	5.9–2.8
	40	5.0	14.0	2.4	0.0	0.0	0.0	4.6–2.4
	41	4.6	14.1	3.1	0.5	5.5	0.2	3.5–2.1
Average		7.8	13.6	3.5	1.5	9.0	0.8	.....

TABLE XXXVIII—*Continued*

Grade	Subject	Average No. of Pauses per Line	Average Length of Pauses	Average Variation for Length of Pauses	Average No. of Regressive Movements	Average Length of Regressive Movements	Average Variation for Length of Regressive Movements	Silent-Reading Rate
H.S.	42	6.0	12.8	2.5	0.0	0.0	0.0	4.9–2.5
	43	6.3	10.4	1.8	1.1	6.0	0.7	6.5–3.5
	44	7.0	.....	.....	0.5	.....	.....	4.7–2.0
	45	8.6	.....	.....	2.1	.....	.....	3.9–2.6
	46	4.6	.....	.....	0.4	.....	.....	4.6–1.9
	47	5.4	11.4	3.3	0.6	4.7	0.0	6.5–3.3
	50	6.2	10.1	2.2	0.6	4.9	0.2	5.1–2.1
	51	7.1	12.8	2.6	1.1	12.4	0.2	4.6–2.1
Average		6.4	11.5	2.5	0.8	5.6	0.2	.....
C	52	5.1	8.7	3.1	1.0	10.3	0.2	8.2–3.8
	53	8.8	11.9	2.9	2.0	10.3	1.8	8.2–3.1
	54	5.0	11.0	1.4	0.1	1.2	0.0	8.2–3.4
	55	8.4	12.3	2.1	1.2	10.6	0.4	4.1–2.4
	56	7.6	9.9	2.5	1.4	12.8	0.8	6.8–3.3
	57	5.2	12.5	2.8	0.7	5.2	0.05	10.0–3.6
	58	6.8	10.4	2.2	1.0	6.9	0.1	6.8–3.1
	59	8.2	13.8	4.3	1.2	7.7	0.5	6.0–2.8
Average		6.9	11.3	2.6	1.1	8.1	0.5	.....

3. Those who make the fewest pauses per line are not those who read the most rapidly. This is shown by Table XXXVIII A.

TABLE XXXVIII A

RELATION BETWEEN READING RATE AND PAUSES PER LINE

Grade	No. of Pauses by Most Rapid Reader	Reading Rate	Fewest Pauses of Any Subject	Reading Rate
3	7.1	5.8–2.5	6.2	4.1–2.2
4	6.7	3.1–1.7	5.6	2.7–1.6
5	7.0	4.1–2.1	7.0	3.5–1.5
6	5.8	6.0–4.3	4.0	5.3–1.8
7	7.0	5.9–2.8	4.6	3.5–2.1
H.S.	6.3	6.5–3.5	4.6	4.6–1.9
C	5.2	10.0–3.6	5.0	8.2–3.4

If the lengths of pauses are compared (Table XXXVIII), it will be seen that in most cases those making the fewest pauses make pauses which are longer than are those of the subjects who make a greater number. This leads to the conclusion that there are two types of rapid readers: those for whom the number of pauses per line is

reduced to a minimum and those for whom the length of the pause is reduced to a minimum. Those readers who make few pauses may be thought of as apprehending a larger number of words with each pause. We may say of them that they have a wide scope of attention. Those who make short pauses are evidently quicker in apprehending what they see, but they commonly have a narrower scope of attention.

This contrast is of the highest importance. Reference to Table XI shows that in five out of the seven grades the most efficient readers are not the most rapid readers. The most efficient reading is done by those who make few pauses and use longer periods of assimilation. This means that certain individuals reduce the period of assimilation to such an extent that their reading ceases to be efficient. These facts suggest important practical principles for the teacher of reading. Teachers should have means at hand to test rapid readers as to whether or not they maintain the proper relation between span of attention and period of assimilation, and to introduce some element into training which will counteract a too short assimilation period.

4. Table XXXVIII shows that in a general way there is a decrease in the number of pauses made in the upper grades as compared with the lower grades.

5. If comparisons are made within the single group, it is found that in every grade except college the slowest reader makes pauses of greater length and number than the most rapid reader. That is, the extreme cases in each group differ both as to span of attention and as to rate of assimilative power.

6. The range in the length of pauses is from 8.7 to 18.2 fiftieths seconds.

7. There is only a slight decrease in the length of pauses in the high-school and college groups as compared with the third and fourth grades. This indicates that the reading of experienced persons improves more in the span of attention than in the rate of perception. A more detailed discussion of this point will be given in the next chapter.

8. Those subjects making three or more regressive movements do not have a rate above 3.6 words per second, as shown in

Table XXXVIII B. Evidently regressive movements are a feature of slow reading.

TABLE XXXVIII B

RELATION BETWEEN READING RATE AND REGRESSIVE MOVEMENTS

Subject	Grade	Average No. of Regressive Movements	Reading Rate	Subject	Grade	Average No. of Regressive Movements	Reading Rate
1.....	3	4.1	3.1–1.3	19...	5	3.2	2.9–1.2
3....	3	4.0	3.6–2.1	22...	5	4.3	2.3–0.8
8....	3	3.0	1.9–0.8	25...	5	4.5	3.0–1.2
9....	3	3.5	2.5–1.9	26...	6	4.5	2.9–0.8
12.....	4	4.5	3.0–1.6	36...	7	3.2	3.4–1.9
15....	4	3.0	2.2–1.0				

9. Table XXXVIII C, which gives the number of regressive movements for the most rapid readers in each grade, shows that in the type of reading required in these experiments regressive movements are largely avoided by rapid readers.

TABLE XXXVIII C

RELATION BETWEEN READING RATE AND REGRESSIVE MOVEMENTS FOR RAPID READERS

Subject	Grade	Average No. of Regressive Movements	Reading Rate	Subject	Grade	Average No. of Regressive Movements	Reading Rate
4....	3	0.3	4.1–2.2	39...	7	1.0	5.9–2.8
10....	4	0.9	3.1–1.7	43...	H.S.	1.0	6.5–3.5
24....	5	2.0	4.1–2.1	57...	C.	0.7	10.0–3.6
30....	6	5.0	6.0–4.3				

10. There is a very material decrease in the number of regressive movements of mature readers, as shown by a comparison of the upper grades with the lower grades.

11. The range in length of the regressive movements is from 1.2 to 19.6 fiftieths of a second. Evidently the short regressive movement must have a significance wholly different from that of the long regressive pauses. In some cases the regressive movements are very short and appear to be readjustments merely incidental to the full pause, while in other cases they are like the forward movements, evidently long enough to permit perception.

Table XXXIX gives the number of pauses, length of pauses, etc., made by sixth-grade subjects in reading the same line. Table XL gives the same type of results for seventh-grade pupils. The point of special interest is the very large amount of variation within the same grade.

TABLE XXXIX

DATA UPON EYE-MOVEMENTS OF SIXTH-GRADE SUBJECTS IN READING THE SAME LINE

(Selection 6, Line 4. Silent Reading)

Subject	No. of Pauses	Average Length of Pauses	Average Variation	No. of Regressive Movements	Average Length of Regressive Movements	Average Variation
26.....	12	.....	.....	3	.....	.....
27.....	4	12.2	3.2	0	0.0	0.0
28.....	10	15.2	2.7	2	18.5	2.5
29.....	5	15.8	2.1	1	16.0	0.0
30.....	5	12.0	2.4	0	0.0	0.0
31.....	5	8.8	0.9	2	10.0	1.0
32.....	5	13.6	2.7	0	0.0	0.0

TABLE XL

DATA UPON EYE-MOVEMENTS OF SEVENTH-GRADE SUBJECTS IN READING THE SAME LINE

(Selection 7, Line 1. Silent Reading)

Subject	No. of Pauses	Average Length of Pauses	Average Variation	No. of Regressive Movements	Average Length of Regressive Movements	Average Variation
33.....	7	.....	.....	2	.....	.....
34.....	10	14.7	4.8	1	14.0	0.0
35.....	8	16.6	6.5	2	14.0	1.0
36.....	8	.....	.....	1	.....	.....
37.....	8	13.7	2.9	1	8.0	0.0
38.....	8	14.5	4.7	1	16.0	0.0
39.....	8	14.5	5.1	1	16.0	0.0
40.....	5	14.0	2.4	0	0.0	0.0
41.....	4	24.5	10.0	0	0.0	0.0

Table XLI makes possible a comparison of the results of various grades for the reading of the same material. From these results it seems to be true that the higher grades do not make any shorter pauses than the lower grades. If the results of Grades 5 and 6 on selection 6 (Part C) are compared, little difference is to be seen in the length of pauses, but the sixth grade makes fewer pauses than the fifth grade.

TABLE XLI

COMPARISON OF RECORDS FOR VARIOUS GRADES IN READING SILENTLY THE SAME MATERIAL

Selection and Grade	Subject	Average No. of Pauses	Average Length of Pauses	Average Variation	Average No. of Regressive Movements	Average Length of Regressive Movements	Average Variation
				A			
Selection 4 Grade 3	3	9.2	14.6	3.9	2.7	16.1	2.6
	6	7.2	19.9	4.9	0.2	3.7	0.0
Average..	.....	8.2	17.2	4.4	1.4	9.9	1.3
Selection 4 Grade 4	10	6.7	10.9	2.3	0.9	5.9	0.3
	11	5.6	10.5	2.7	1.2	9.5	1.0
	12	11.0	.....	.....	4.5	.....	.....
	13	7.4	.....	.....	1.6	.....	.....
	15	12.3	16.9	3.7	3.0	15.2	2.5
	17	11.5	11.9	2.9	1.5	15.5	1.5
Average..	.....	9.0	12.5	2.9	2.1	11.5	1.3
				B			
Selection 5 Grade 4	10	5.9	11.3	2.5	0.6	4.3	0.15
	11	5.6	.....	.....	1.0	.....	.....
	12	11.6	.....	.....	3.0	.....	.....
	13	6.3	12.5	3.2	1.1	4.3	0.4
	15	11.0	17.8	7.3	3.0	14.5	6.5
	17	12.3	13.4	3.5	3.0	11.8	3.3
Average..	.....	8.8	13.7	4.1	1.9	8.7	2.6
Selection 5 Grade 5	18	9.0	14.7	4.3	1.0	8.6	0.3
	19	10.7	11.3	3.3	3.2	12.8	4.3
	21	7.0	14.5	4.2	1.0	11.1	0.4
	22	13.0	.....	.....	4.3	.....	.....
	23	10.3	12.6	2.9	1.0	15.3	0.0
	24	7.0	16.0	3.1	2.0	12.5	0.5
	25	13.0	.....	.....	4.5	.....	.....
Average..	.....	10.0	13.8	3.5	2.4	12.0	1.1
				C			
Selection 6 Grade 5	18	10.2	13.2	3.5	1.1	8.8	0.8
	19	9.8	12.6	4.0	1.8	7.9	0.6
	21	6.0	14.6	2.8	1.0	13.2	0.0
	22	9.7	12.1	3.1	2.7	10.7	1.5
	23	7.4	12.8	3.1	1.3	11.7	0.3
	24	9.6	10.1	2.5	1.6	13.1	1.0
	25	13.0	14.4	4.6	3.0	18.1	4.7
Average...	.....	9.4	12.8	3.4	1.8	11.9	1.3

TABLE XLI—*Continued*

Selection and Grade	Subject	Average No. of Pauses	Average Length of Pauses	Average Variation	Average No. of Regressive Movements	Average Length of Regressive Movements	Average Variation
Selection 6 Grade 6	26	15.5	15.4	5.7	4.5	13.4	3.4
	27	4.0	12.2	3.2	0.0	.....	.....
	28	9.3	13.9	3.4	1.7	15.6	1.7
	29	6.3	12.1	2.4	1.1	9.1	0.5
	30	5.8	11.2	2.1	0.5	3.9	0.2
	31	4.6	11.0	2.7	1.0	10.3	0.2
	32	7.5	11.5	2.0	1.0	6.8	1.8
Average...	.....	7.5	12.5	3.1	1.4	9.8	1.3
			D				
Selection 7 Grade 6	26	14.0	14.6	4.0	4.0	13.2	2.8
	27	8.6	13.3	3.3	1.8	9.7	1.9
	28	8.6	14.8	5.1	1.3	11.1	1.1
	29	6.6	11.4	2.5	1.1	7.0	0.7
	30	6.3	10.6	2.3	1.3	7.7	0.6
	31	5.6	12.7	2.7	1.2	11.9	0.7
	32	7.3	11.1	2.6	1.0	5.5	0.9
Average ..	.....	8.1	12.6	3.2	1.7	9.4	1.2
Selection 7 Grade 7	33	7.0	.....	.....	2.0	.....	.....
	34	10.5	15.3	4.3	2.0	13.3	1.2
	35	9.3	14.4	4.7	2.0	17.7	1.5
	36	10.7	11.4	3.5	3.2	11.0	2.2
	37	8.2	13.5	3.4	0.7	4.4	0.1
	38	8.1	13.1	3.3	2.0	10.4	0.6
	39	7.0	12.9	3.5	1.0	9.5	0.8
	40	5.0	14.0	2.4	0.0	0.0	0.0
	41	4.6	14.1	3.1	0.5	5.5	0.2
Average ..	.....	7.8	13.6	3.5	1.5	9.0	0.8
Selection 7 H.S.	42	6.0	12.8	2.5	0.0	0.0	0.0
	43	6.3	10.4	1.8	1.1	6.0	0.7
	44	7.0	.....	.....	0.5	.....	.....
	45	8.6	.....	.....	2.1	.....	.....
	46	4.6	.....	.....	0.4	.....	.....
	47	5.4	11.4	3.3	0.6	4.7	0.0
	50	6.2	10.1	2.2	0.6	4.9	0.2
	51	7.1	12.8	2.6	1.1	12.4	0.2
Average ..	.....	6.4	11.5	2.5	0.8	5.6	0.2
			E				
Selection 8 Grade 7	36	9.7	11.2	2.3	2.5	9.1	1.2
	37	9.3	12.7	3.0	1.0	8.6	0.4
	38	10.0	12.1	3.6	2.8	14.0	2.8
	39	6.6	12.0	2.9	0.7	4.5	0.4
	41	5.3	12.7	2.8	1.1	10.2	0.7
Average ..	.....	8.2	12.1	2.9	1.6	9.3	1.1

TABLE XLI—*Continued*

Selection and Grade	Subject	Average No. of Pauses	Average Length of Pauses	Average Variation	Average No. of Regressive Movements	Average Length of Regressive Movements	Average Variation
Selection 8 H.S.	43	4.7	11.4	2.3	0.5	4.0	0.3
	44	7.0	.....	.....	1.0	.....	.....
	45	8.5	9.1	2.3	1.0	2.7	0.2
	46	4.3	.....	.....	0.0	0.0	0.0
	47	5.5	11.3	2.4	0.9	7.2	0.5
	48	5.2	11.2	2.4	0.0	0.0	0.0
	50	6.4	10.8	2.8	0.6	6.1	0.9
Average ..	.....	5.9	10.7	2.4	0.6	3.3	0.3
Selection 8 C.	52	5.1	8.7	3.1	1.0	10.3	0.2
	53	8.8	11.9	2.9	2.0	10.3	1.8
	54	5.0	11.0	1.4	0.1	1.2	0.0
	55	8.4	12.3	2.1	1.2	10.6	0.4
	56	7.6	9.9	2.5	1.4	12.8	0.8
	57	5.2	12.5	2.8	0.7	5.2	0.05
	58	6.8	10.4	2.2	1.0	6.9	0.1
	59	8.2	13.8	4.3	1.2	7.7	0.5
Average ..	.....	6.9	11.3	2.6	1.1	8.1	0.5
			F				
Selection 9 C.	52	5.3	9.4	2.1	0.8	7.7	0.1
	53	7.2	12.4	2.4	1.0	11.3	0.3
	54	4.5	10.3	1.9	0.0	0.0	0.0
	55	6.8	14.1	3.9	0.3	3.6	0.0
	56	5.5	10.3	4.8	1.0	3.7	0.2
	57	4.3	12.7	2.8	0.7	2.1	0.1
	58	5.4	11.8	1.8	0.4	1.7	0.1
	59	8.3	13.3	2.6	1.8	13.0	0.5
Average ..	.....	5.9	11.8	2.8	0.7	5.4	0.1

RECORDS FOR ORAL READING

Records were also taken for oral reading. The difficulties produced by head-movements were much greater and more of the records had to be discarded than in silent reading. Those which were satisfactory have been studied in the same way as the silent-reading records. Table XLII gives results for the various grades. An examination of this table shows the following points:

1. If the college or high-school groups are contrasted with the lower grades, it will be noted that there is a marked difference in the number of pauses.

2. There is also a small decrease in the length of the pauses.

3. The total number of pauses made by the most rapid reader in each grade is shown in Table XLII A.

TABLE XLII

DATA CONCERNING EYE-MOVEMENT RECORDS IN ORAL READING

Selection and Grade	Subject	Average No. of Pauses	Average Length of Pauses	Average Variation	Average No. of Regressive Movements	Average Length of Regressive Movements	Average Variation	Oral Rate
Selection 4 Grade 4	10	11.3	.....	.....	0.7	.....	.....	3.8–1.2
	13	13.0	15.6	2.9	4.0	16.7	3.2	2.8–0.6
	16	13.0	16.3	5.3	4.0	11.3	3.1	3.2–1.0
	17	16.0	11.3	2.5	4.0	11.3	2.9	2.7–0.8
Average..	.....	13.3	14.4	3.5	3.2	13.1	3.1	.....
Selection 5 Grade 5	21	9.0	12.1	1.6	3.0	13.3	1.1	4.8–1.0
	22	9.7	.....	.....	1.7	.....	.....	3.5–1.2
	23	10.0	.....	.....	2.0	.....	.....	4.3–1.0
	24	8.6	15.4	6.3	1.6	13.8	2.8	3.8–0.9
Average..	.....	9.3	13.7	3.9	2.1	13.5	1.9	.....
Selection 6 Grade 6	30	9.0	13.5	5.2	3.0	10.0	0.0	3.7–1.7
	31	9.0	12.5	5.6	3.0	15.0	8.0	4.6–1.6
Average..	.....	9.0	13.0	5.4	3.0	12.5	4.0	.....
Selection 7 Grade 7	34	11.5	15.2	6.4	3.0	12.5	0.0	3.5–1.0
	36	11.3	11.2	2.8	4.6	12.8	3.4	3.7–0.9
	37	10.0	13.5	3.8	1.0	5.0	0.0	4.6–1.0
	38	14.0	12.3	4.3	5.0	12.1	3.0	3.6–0.9
	39	9.8	12.2	2.8	2.2	12.0	1.6	4.3–1.3
	40	8.2	12.4	3.7	1.0	9.5	0.2	4.1–1.7
	41	9.5	15.3	5.9	2.5	18.1	2.1	4.1–1.6
Average..	.....	10.6	13.1	4.2	2.7	11.7	1.5	.....
Selection 8 H.S.	43	10.2	11.0	2.7	2.6	7.4	1.2	4.1–2.2
	45	7.8	.....	.....	2.0	.....	.....	4.8–1.8
	47	7.0	13.6	3.6	0.8	8.1	0.1	4.3–1.9
	48	6.7	17.6	5.4	0.0	0.0	0.0	4.6–1.7
	50	7.5	9.0	3.0	0.0	0.0	0.0	5.3–2.1
Average..	.....	7.8	12.8	3.7	1.1	3.9	0.3	.....
Selection 8 C.	53	9.7	12.4	3.6	2.1	12.3	3.3	4.8–2.2
	54	8.8	12.0	2.9	0.8	3.4	0.7	4.5–1.8
	55	7.7	15.9	4.2	0.8	5.1	0.9	4.0–2.1
	56	9.6	11.4	2.8	2.4	10.9	2.2	4.8–1.7
	57	8.7	12.7	3.5	2.1	9.9	1.6	4.9–2.1
	59	8.2	13.3	3.4	1.4	5.3	0.7	5.0–1.3
Average..	.....	8.8	12.9	3.4	1.6	7.8	1.6	.....

A further examination of Table XLII shows that in every grade except the fourth other individuals either make as few pauses as, or fewer than, the subjects referred to in Table XLII A. In other words, the smallest number of pauses does not accompany the most rapid reading.

TABLE XLII A

RELATION BETWEEN NUMBER OF PAUSES AND READING RATE

Grade	Subject	No. of Pauses	Reading Rate	Grade	Subject	No. of Pauses	Reading Rate
4.....	10	11.3	3.8–1.2	7....	37	10.0	4.6–1.0
5.....	21	9.0	4.8–1.0	H.S..	50	7.5	5.3–2.1
6.....	31	9.0	4.6–1.6	C....	59	8.2	5.0–1.3

4. The range in length of pauses is from 9.0 to 17.6 fiftieths seconds.

5. If the relation between the length and number of pauses is studied, it will be seen that the longest pauses (17.6) are made by the subject (No. 48) who makes the least number of pauses (6.7). The shortest pauses (9.0) are made by an individual (No. 50) who makes only 7.5 pauses per line. Further, it may be noted that the subject (No. 17) who makes the largest number of pauses (16.0) has an average of 11.3 fiftieths seconds for each of them. This study of typical cases is enough to show that there is no close relation between the length of pauses and the number of pauses.

Table XLIII compares the results for oral and silent reading. Twenty-one out of the twenty-six subjects make fewer pauses per line in silent than in oral reading. A comparison of the average number of pauses made by the various grades shows that all grades, including the high-school and college groups, make fewer pauses in silent than in oral reading, with the single exception of the fifth grade, where there is no difference. If the length of pauses for the two types of reading is compared, it is found that eleven of the twenty-six subjects have slightly shorter pauses in silent than in oral reading.

If the average lengths of the pauses for the various grades for the two types of reading are compared, it is seen that in the fourth and sixth grades and in the high-school and college groups the average for silent reading is shorter than for oral reading.

Table XLIV shows the individual variations made in number of pauses, length of pauses, etc., by members of the seventh grade

TABLE XLIII

COMPARISON OF ORAL- AND SILENT-READING RESULTS

Grade	Subject	Average No. of Pauses Oral Reading	Average No. of Pauses Silent Reading	Average Length of Pauses Oral Reading	Average Length of Pauses Silent Reading
4	10	11.3	6.7	.....	10.9
	13	13.0	7.4	15.6	.....
	17	16.0	11.5	11.3	11.9
Average	.....	13.4	8.5	13.4	11.4
5	21	9.0	7.0	12.1	14.5
	22	9.7	13.0	.....	.....
	23	10.0	10.3	.....	12.6
	24	8.6	7.0	15.4	16.0
Average	.....	9.3	9.3	13.7	14.3
6	30	9.0	5.8	13.5	11.2
	31	9.0	4.6	12.5	11.0
Average	.....	9.0	5.2	13.0	11.1
7	34	11.5	10.5	15.2	15.3
	36	11.3	10.7	11.2	11.4
	37	10.0	8.2	13.5	13.5
	38	14.0	8.1	12.3	13.1
	39	9.8	7.0	12.2	12.9
	40	8.2	5.0	12.4	14.0
	41	9.5	4.6	15.3	14.1
Average	.....	10.6	7.7	13.1	13.4
H.S.	43	10.2	4.7	11.0	11.4
	45	7.8	8.5	.....	9.1
	47	7.0	5.5	13.6	11.3
	50	7.5	6.4	9.0	10.8
Average	.....	8.1	6.3	11.2	10.0
C	53	9.7	8.8	12.4	11.9
	54	8.8	5.0	12.0	11.0
	55	7.7	8.4	15.9	12.3
	56	9.6	7.6	11.4	9.9
	57	8.7	5.2	12.7	12.5
	59	8.2	8.2	13.3	13.8
Average	.....	8.8	7.2	12.9	11.9

while reading the same line of material orally. Here greater variation is found in the number of pauses than in the length of pauses.

EYE-MOVEMENTS IN DIFFERENT TYPES OF READING

In the tests for oral and silent reading evidence was reported showing that there are different types of reading, according as the reader prepares to answer questions or prepares to make an outline

TABLE XLIV

INDIVIDUAL VARIATIONS IN READING ORALLY THE SAME LINE

(Selection 7, Line 2. Seventh Grade)

Subject	No. of Pauses	Length of Pauses	Average Variation	No. of Regressive Movements	Length of Regressive Movements	Average Variation
34.....	10	13.5	5.6	2	11.0	0.0
36.....	14	12.0	2.3	4	13.5	3.2
37.....	10	14.3	3.7	0	0.0	0.0
38.....	9	14.2	7.8	1	.....	0.0
39.....	7	12.5	3.2	1	13.0	0.0
40.....	7	10.4	1.8	0	0.0	0.0
41.....	7	13.6	5.0	1	.....	0.0

or a full reproduction. This suggested that photographs be taken to see if any differences appeared in the eye-movements during these different kinds of reading. The records which have been taken and discussed previously may be thought of as due to one type of reading. In such reading the subject was expected to read for an intelligent understanding of the material. Three other types of records were taken. One of these was of reading, which was followed by the answering of questions on prose; another was a passage of poetry, with the answering of questions; and a third was the reading of prose for reproduction. The material for the prose tests was selected from the book from which material was taken for the test described above. All the prose selections may be thought of as being about equal in difficulty, but the poetry was easier, as indicated by the fact that each of the subjects remarked after the tests that the poetry was easy.

In taking the record the subjects were told that the material was to be read, in the one case, with the purpose of answering questions, in the other, with the idea of reproducing it. As soon as one selection was read, the subject was released from the headrest and was given the task agreed on. He was given either a sheet of

paper upon which the questions were written or a blank sheet for the reproduction. As soon as the writing was done, the subject was again seated at the apparatus, a second selection was read, and so on until the three types of reading had been recorded. Three adult subjects were used in this part of the experiment.

Table XLV gives the number and length of the pauses for the various types of reading for one subject. These results indicate clearly that the reader does differentiate between different types of reading and evidently approaches different reading problems with a different mental "set." The results here reported are typical of all the subjects. It is also interesting to note that the length of the pauses does not vary in any large degree, while the number of pauses varies greatly.

TABLE XLV

EYE-MOVEMENT RECORD OF ONE SUBJECT IN VARIOUS TYPES OF SILENT READING

LINE	NO. OF PAUSES				AVERAGE LENGTH OF PAUSES			
	Prose	Prose (Answering Questions)	Poetry (Answering Questions)	Reproduction	Prose	Prose (Answering Questions)	Poetry (Answering Questions)	Reproduction
1.....	9	10	14	9	13.1	14.8	15.7	15.5
2.....	12	6	10	7	11.3	17.6	11.5	14.2
3.....	9	8	12	10	.....	16.1	15.7	15.5
4.....	7	12	15	8	12.7	12.5	14.2	17.0
5.....	7	9	11	8	.....	13.1	14.6	12.2
6.....	8	13	8	7	15.3	14.8	12.8	14.5
7.....	7	10	10	11	.....	13.7	11.0	12.5
8.....	7	9	8	10	11.8	13.9	15.3	12.7
9.....	7	10	7	7	15.8	12.4	16.1	14.2
10.....	.....	10	10	10	.....	12.3	13.7	17.5
11.....	.....	8	15	.....	.....	12.7	14.1	.....
12.....	.....	9	12	.....	.....	12.0	13.8	.....
13.....	.....	11	.....	.....	.....	14.3	.....	.....
Average	8.1	9.6	11.0	8.7	13.3	13.9	14.0	14.6

Table XLVI shows the number of regressive movements. Here, again, the variation from one type of reading to another is striking. Such results indicate a method of reading. In Plate VIII, *E* shows the eye-movements of one of these subjects while he is reading poetry. It is evidently true that this subject has deliberately moved his eye back and forth in each line as a method of compre-

hension. This doubtless means that the regressive movement plays a large part in careful and detailed reading. In other words, regressive movements may in this case be thought of as related to the mental processes of comprehension. It is clear, in the record shown in Plate VIII, that this reader has made long strides forward and has then gone backward. It is as though the forward move-

TABLE XLVI

NUMBER OF REGRESSIVE MOVEMENTS IN VARIOUS TYPES OF SILENT READING FOR ONE SUBJECT

Line	Selection 9 Prose	Prose (Answering Questions)	Poetry (Answering Questions)	Reproduction	Line	Selection 9 Prose	Prose (Answering Questions)	Poetry (Answering Questions)	Reproduction
1.....	1	3	5	3	9....	1	3	0	1
2.....	4	0	4	0	10....	.....	3	2	2
3.....	3	2	4	3	11....	.....	2	4	.....
4.....	1	3	5	1	12....	.....	2	4	.....
5.....	1	3	3	2	13....	.....	2	.....	.....
6.....	2	4	3	1					
7.....	1	2	5	3	Av.	1.8	2.4	3.3	1.8
8.....	2	2	1	2					

ment were made for the purpose of getting a general idea of the situation and then the attention shifted backward in order that the meaning might be finally comprehended. This matter should be studied further, in order to determine whether the poor reader shows characteristically movements of the regressive type. It would be of interest also to study in detail the development of such methods of reading through the several school grades.

THE LOCATION OF POINTS OF FIXATION

The location of the points of fixation on the lines read was accomplished by placing the film showing the fixation points in one projecting lantern and the selection in a second lantern above it so that both records, one superimposed on the other, could be thrown on a screen. The eye began by fixating a point which was put just outside the reading matter (Plate VIII, record *D*). The fixation point at which the eye began being thus determined, the

further fixations were determined by the amount of horizontal movement away from this first point. Plates X–XV give details from records of both good and poor readers. The vertical lines indicate the points of fixation, and the digits above indicate the order of fixations in the series. The last line shown for No. 1 is very interesting. The word "sparkles" has been spelled out.

No. 4 is in the same grade with No. 1, and no comment is necessary to bring out the contrast. The same type of contrast as that between No. 1 and No. 4 can be drawn between the records of W. E. and B. R. (Plates XIII and XIV). After B. R. had had practice in rapid reading, his record shows a very striking decrease in the number of pauses.

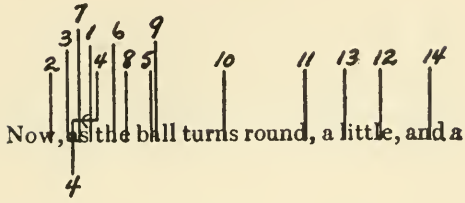
As do many other subjects, No. 3 (Plate X) requires more fixations for the first line of a selection than any thereafter. This is probably due to the fact that it takes a certain length of time for the child to get into the swing of the selection. The regressive movement that often occurs near the beginning of the first line of a selection, according to Dearborn, is due to the fact that the motor habit of the eye for the selection is not yet established.

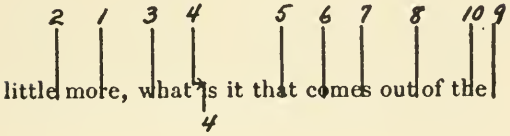
FIXATIONS IN ORAL READING

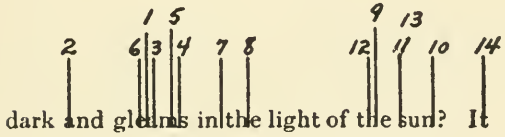
As has been stated, records for oral reading were taken with the camera and an Edison dictaphone. A photographic shutter, which had been reversed so that it closed for a fraction of a second, was placed in the path of the light entering the eye. The shutter was closed with each rotation of the phonograph cylinder by means of a solenoid controlled by a cam on the shaft of the dictaphone. This shutter made a small gap in the eye-movement record, as shown in *D* of Plate IX. The cam also operated a second solenoid, which sounded a bell that was inclosed in a box. The sound of the bell was recorded on the wax cylinder at the same time as the record of the shutter upon the film, so that it was possible to synchronize voice with the eye-movement records.

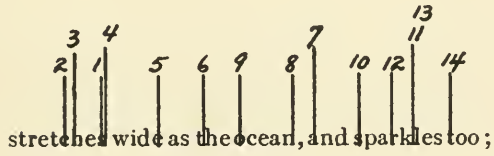
Plates XVI–XXII show the records of different individuals. The vertical lines indicate again the fixation points. The crosses above certain vertical lines indicate the gaps made by the closing of the shutter referred to in the foregoing paragraph. In some

PLATE X



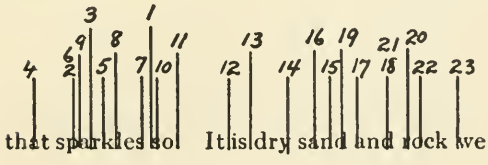






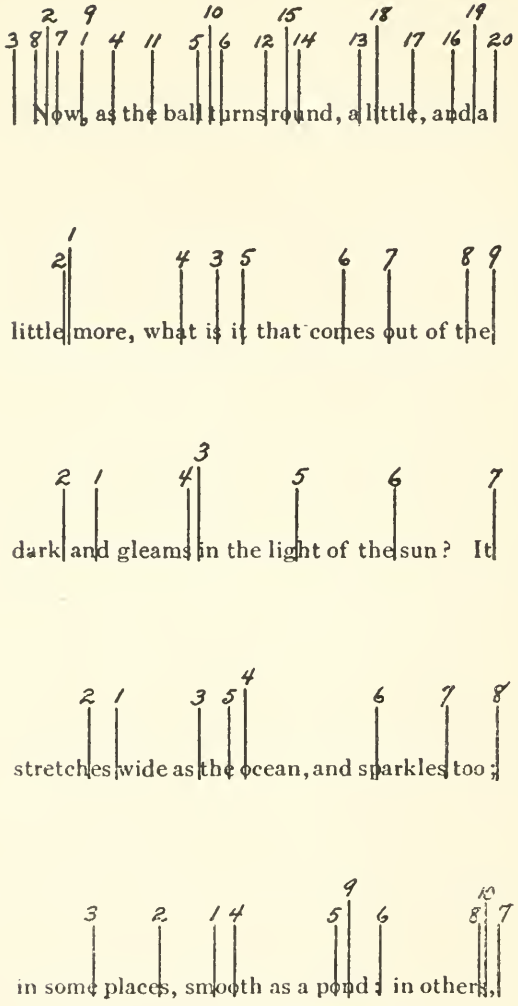
in some places, smooth as a pond; in others,

rolling as ocean waves. But it is not water



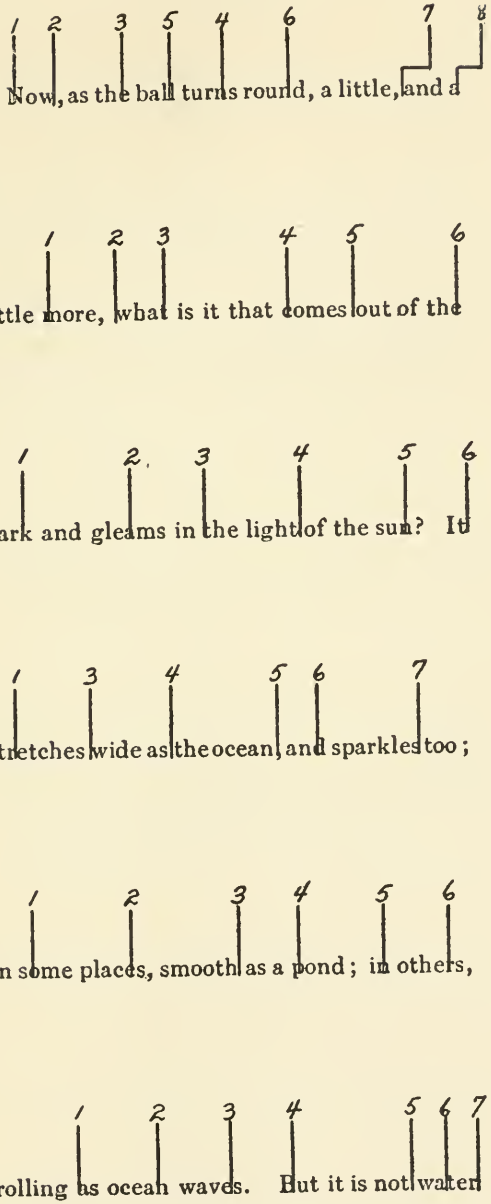
Location of eye-movement fixations
Subject No. 1 Silent reading

PLATE XI



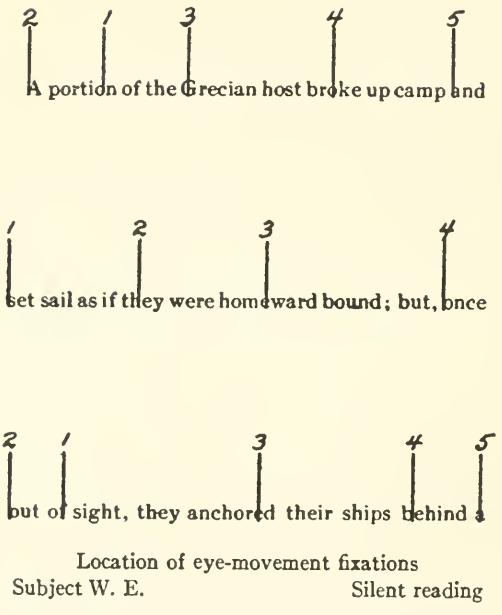
Location of eye-movement fixations
Subject No. 3 Silent reading

PLATE XII



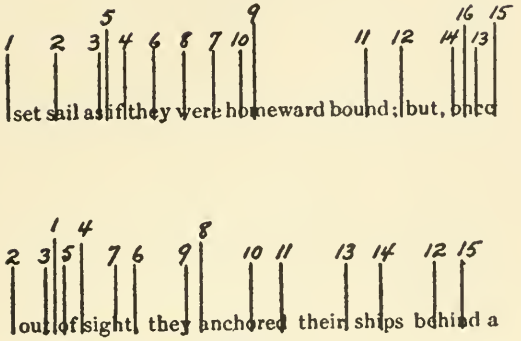
Location of eye-movement fixations
Subject No. 4 Silent reading

PLATE XIII



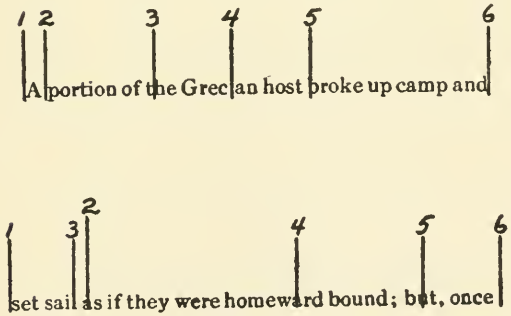
Location of eye-movement fixations
Subject W. E. Silent reading

PLATE XIV



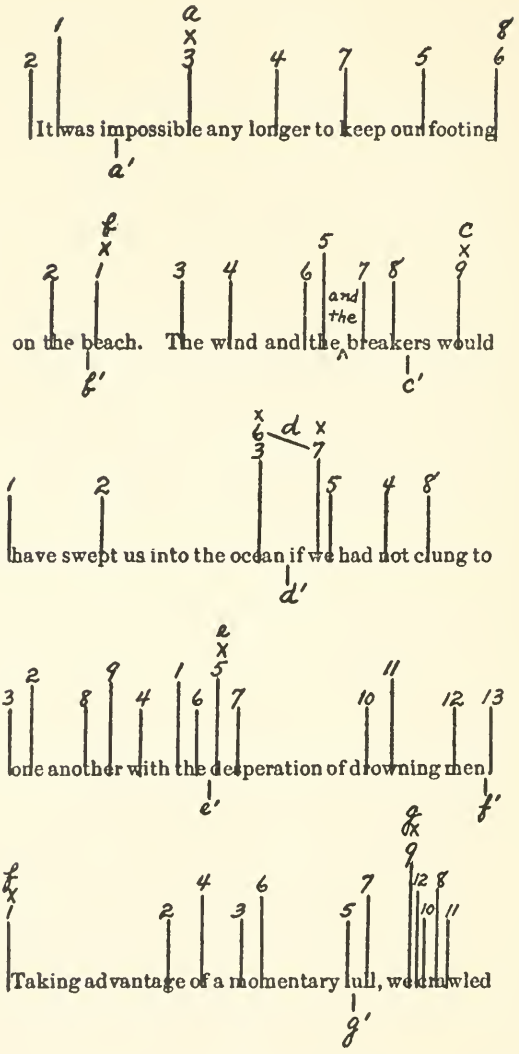
Location of eye-movement fixations
Subject B. R. Silent reading

PLATE XV



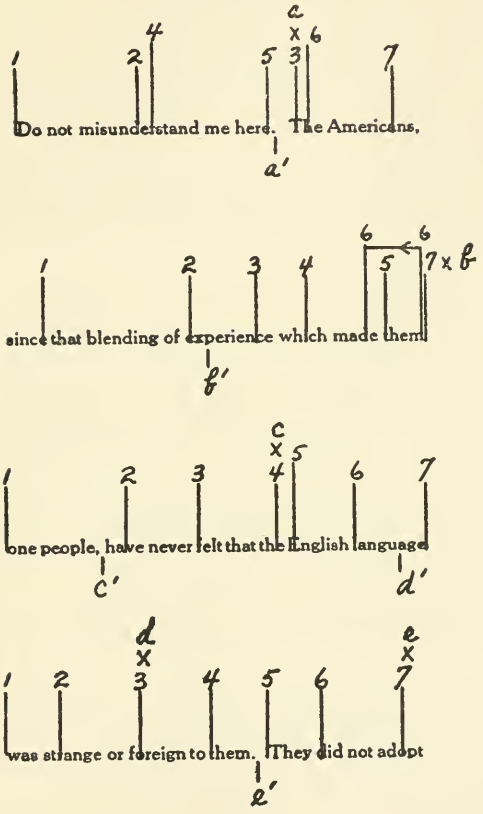
Location of fixation pauses in silent reading for B. R. after twenty days practice in rapid reading.

PLATE XVI



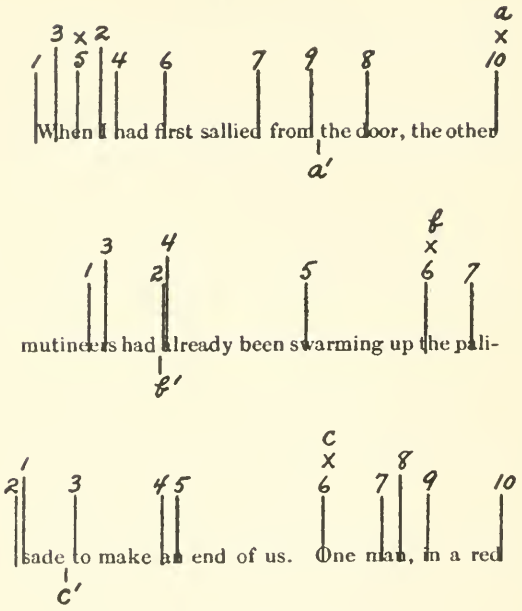
Location of eye-movement fixations and eye-voice span in oral reading.
Subject No. 43(A).

PLATE XVII



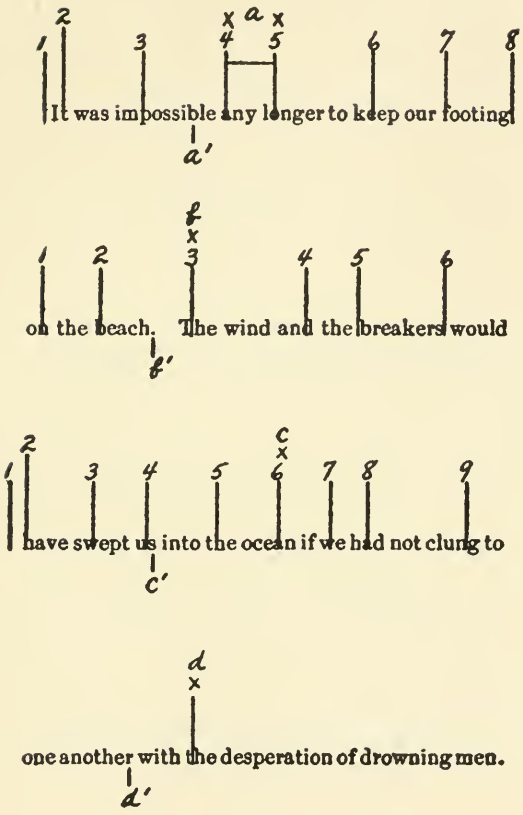
Location of eye-movement fixations and eye-voice span in oral reading.
Subject No 43(B).

PLATE XVIII

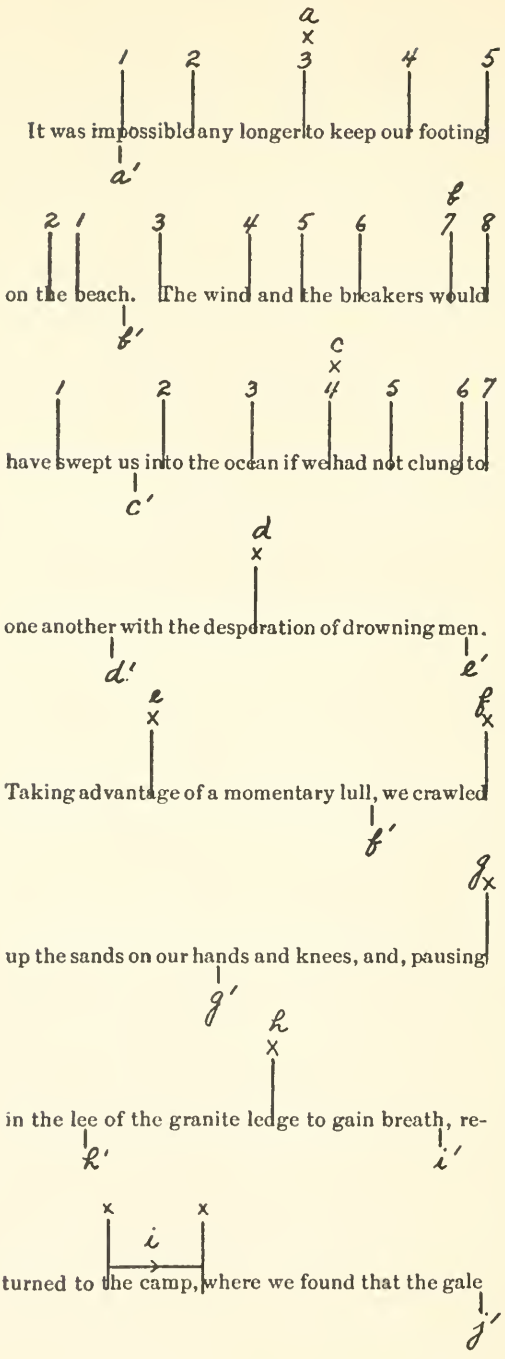


Location of eye-movement fixations and eye-voice span in oral reading.
Subject No. 39.

PLATE XIX

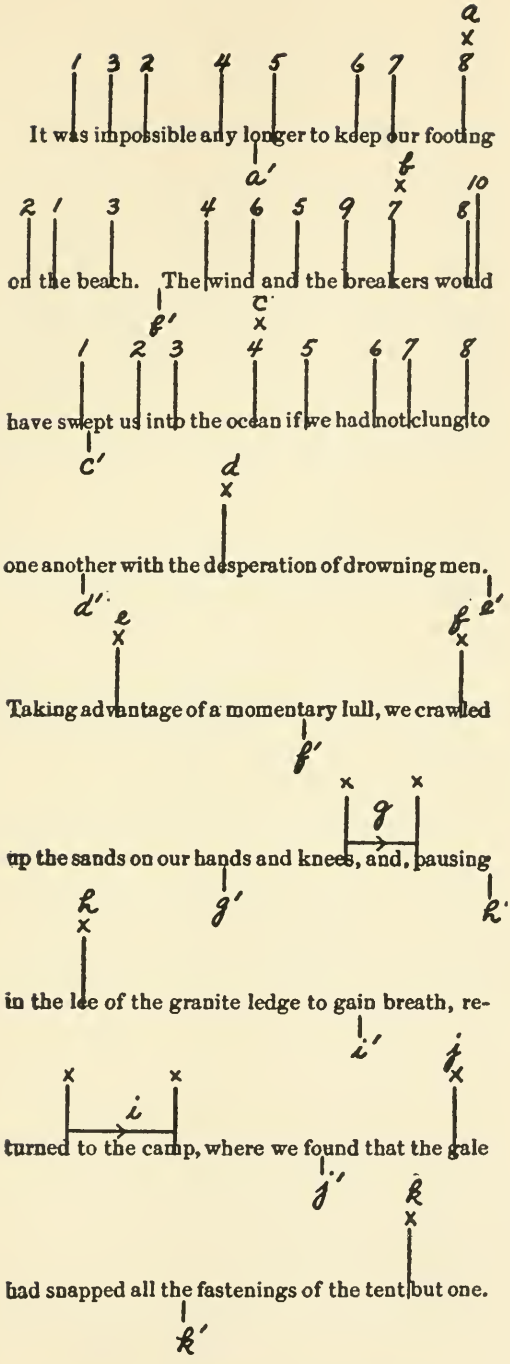


Location of eye-movement fixations and eye-voice span in oral reading.
Subject No. 54.



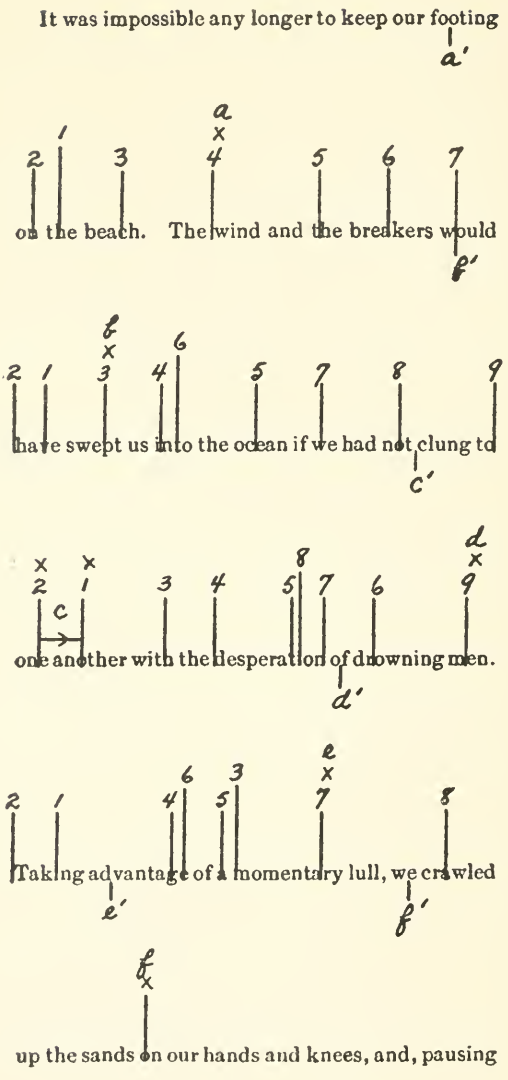
Location of eye-movement fixations and eye-voice span in oral reading.
Subject No. 55.

PLATE XXI



Location of eye-movement fixations and eye-voice span in oral reading.
Subject No. 53.

PLATE XXII



Location of eye-movement fixations and eye-voice span in oral reading.
Subject No. 45.

cases the shutter cut off a part of two movements. These cases are indicated by two crosses, one following immediately after the other. Furthermore, each cross is accompanied by a letter, and below the line are letters to show where the voice was when the eye was fixating at the point indicated by the cross. Thus, when the eye in each record is at *a*, the voice is at *a'*; when the eye is at *b* the voice is at *b'*; etc.

So far as the location of fixations is concerned, no new points seem to be brought out for oral reading. There are more pauses and more regressive movements. A number of the small words receive a fixation and a number of the larger words have two fixations.

There are two distinct types of eye-voice separation. One type is represented by subject No. 53 (Plate XXI), who keeps a distance of three or four words between eye and voice; the other type by No. 54 (Plate XIX), who keeps eye and voice very close together. By referring to Table VIII, on page 34, it will be seen that No. 53 is one of the best oral readers in the entire group of subjects, while the record of No. 54 does not have such a high rank. A long span between eye and voice probably gives the subject an opportunity to anticipate what is coming and to carry out the interpretation more successfully.

An examination of the first record for No. 43A (Plate XVI) shows a very close relation between fixation and articulation, while the second record (Plate XVII) shows that this relation may change in a very marked way within the same selection. The separation is greater in all cases in the second record than in the first. Such variations are probably due to fluctuations in attention as well as to changes in subject-matter.

Certain general comments may be made regarding the eye-movements involved in the reading process.

1. Fixations which are made in a forward direction divide themselves into three classes: those which are determined by the length of the span of attention, those which fall within or near short words, and those which are used in making a detailed analysis of single words.

2. Regressive movements divide themselves into four classes: first, those which accompany the slow and tedious reading caused

by lack of familiarity with language form and failure to get meaning; second, those which accompany very rapid reading, where it becomes necessary for the reader to go back and connect up the different fields of vision; third, those which indicate a phase of technique used in careful and detailed reading; fourth, as has been emphasized by Dearborn, such movements as occur near the beginning of a passage before the motor habit of the eye becomes established.

3. The number of pauses decreases as progress is made through the various school grades.

4. A large number of fixations results in slow reading, while a small number of fixations facilitates rapid reading. However, the most rapid readers do not always have the smallest number of fixations.

5. Very little change is made in the length of pauses as we pass from grade to grade or from slow to rapid reading, which emphasizes the fact that span of attention changes more than does the rate at which assimilation takes place.

6. The separation between eye and voice in oral reading varies from individual to individual or from point to point within the same selection.

OCULISTS' TESTS

It seemed wise in connection with this work on visual fixations to make sure that optical defects in the various subjects studied did not vitiate the results. A series of tests were therefore performed with a number of subjects. For this purpose some good readers were selected and some poor. The experiment was not carried far enough to correct any of the defects by means of glasses. In a few cases it would have been interesting to determine the effect of glasses, but it was not thought practicable, since it takes a considerable period of time for a subject to become accustomed to them. Moreover, the particular persons found in need of glasses were good readers, and the results of treatment, while interesting in themselves, would not have explained the poor reading of the normal persons tested.

All the apparatus used was standard material sold by F. A. Hardy & Company, Chicago. Myopia, hyperopia, astigmatism,

and accommodation were tested by means of the punctometer. In this instrument the lens scale and charts used are so constructed as to give all the results in dioptres.

Visual acuity and binocular vision were tested by the Hardy diaphragm test. Fig. 7 gives the essential points of this instrument. The test card is placed at *T* and is seen through the opening in *D*. The right and left wings of the test card are seen by the left and right eyes, respectively, and a narrow median band of the card is

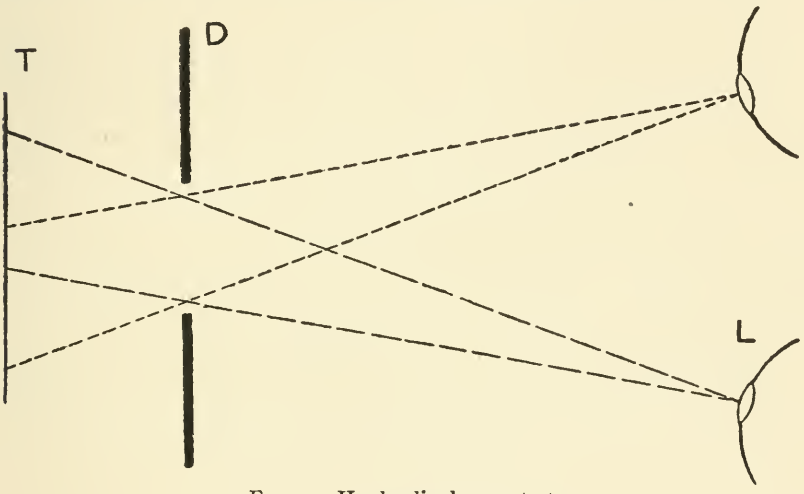


FIG. 7.—Hardy diaphragm test
T—Test card
D—Diaphragm
Left eye

seen by both eyes. To determine the quality of visual acuity, rather large letters or figures are used, and if there is no difference in the clearness of the letters or figures the eyes have equal vision. To determine the presence, the absence, or a defect in binocular vision, cards with printed matter or with small letters or figures are used.

The muscular co-ordinations of the eyes were tested by means of De Zeng's phorometer No. 537. This includes a double rotary and mobile prism unit on each side, a red and a white Maddox multiple rod, and a Stevens phorometer. The experimenter is able to locate any imbalance of the muscles and to make a duction test of each

muscle of each eye separately, in order to determine which muscle or muscles of either or both eyes, as the case may be, are at fault.

The results from these tests showed clearly that eye defects have nothing to do with reading ability. In fact, if there is any difference, the good readers have more defects than the poor readers. The worst case of astigmatism was found in a fourth-grade boy who was the best reader in the group.

In addition to the eye tests which have just been reported, an examination was made of the peripheral vision of a number of subjects by means of a perimeter. The instrument used had a small light for a fixation point, and a second white light moved either in or out on the scale. A headrest was provided, and the work was done in a semi-darkened room. The experimenter sat where the eyes of the subject were under observation, and continual cautioning was necessary in order to keep the children from turning their eyes toward the light on the margin rather than fixating the light straight ahead. Records were made by moving the light on the scale both in and out, the different meridians used being 0, 15, 30, 45, 60, and so on, for the entire 360 degrees.

This work may be summarized briefly by saying that no difference could be found in the peripheral vision of poor and good readers.

CHAPTER IV

PERCEPTION TESTS

In the last chapter certain motor processes were studied in their relation to rate, comprehension, and other phases of oral and silent reading. In this chapter it is proposed to present the results of experiments on visual perception. Short-exposure tests were the first to be tried. The apparatus is shown in Fig. 6. By means of a lantern (*A*) fitted with a high-grade photographic lens and shutter (*B*) seventeen easy sentences ranging from two to seven words in length were projected on a mirror (*C*) and from this to a plaster-of-Paris surface (*D*), allowing eleven-fiftieths seconds for each exposure. Different speeds of the shutter were tried, and eleven-fiftieths was decided on as a rate at which every grade of reader could get something from the exposures. The speed of the shutter was determined by placing both it and a fifty-vibration tuning fork in the path of a beam of light and photographing the beam during the opening of the shutter on the moving film used in photographing eye fixations.

In using this apparatus it is necessary to guard against after-images, and great care must be exercised in making the photographic slides, in order that the same degree of illumination be maintained throughout the entire group.

TABLE XLVII

RECORDS FOR B. R. AND W. E. IN FIRST PERCEPTION TEST

No. of Words Exposed	Average No. of Words Correct—W.E.	Average No. of Words Correct—B.R.
2	2.0	1.6
3	3.0	1.0
4	3.6	1.3
5	4.0	1.3
6	5.3	1.6

Table XLVII gives the perception records for two selected subjects—W. E. and B. R., who have been contrasted in most of

TABLE XLVIII

Record for All Subjects in First Perception Test

Subject	Average on 2 Words	Average on 3 Words	Average on 4 Words	Average on 5 Words	Average on 6 Words	Average on 7 Words	Average Span	Silent-Reading Rate	Minimum-Rate Group
1	1.6	1.3	0.0	0.6	0.5	0.0	0.7	3.1–1.3	2
2	2.0	3.0	3.0	3.5	2.8	2.5	2.8	4.5–2.5	3
3	2.0	2.6	3.0	2.6	3.6	3.5	2.9	3.6–2.1	3
4	2.0	2.3	2.1	3.3	2.6	2.5	2.5	4.1–2.2	3
5	1.2	1.2	1.6	1.0	2.0	3.0	1.7	1.9–1.5	2
6	1.3	2.0	2.7	2.0	3.0	2.0	2.2	3.3–1.9	2
7	2.0	2.3	2.8	2.6	3.5	2.2	2.6	5.8–2.5	3
8	2.0	0.5	1.2	1.0	2.3	2.2	1.5	1.9–0.8	1
9	1.6	0.6	1.2	1.6	1.3	1.7	1.3	2.5–1.9	2
10	2.0	2.6	3.2	2.3	3.2	.....	2.7	3.1–1.7	2
11	1.8	3.0	3.6	4.0	4.0	.....	3.3	2.7–1.6	2
12	2.0	2.5	4.0	3.6	3.3	.....	3.1	3.0–1.6	2
13	1.5	2.2	2.3	2.0	3.6	.....	2.3	2.4–1.3	2
14	2.0	2.3	2.5	2.3	2.6	.....	2.3	3.4–1.5	2
15	1.8	2.5	2.5	3.0	3.3	.....	2.6	2.2–1.0	1
16	2.0	2.5	2.2	3.6	2.3	2.5	2.5	2.9–0.9	1
17	1.3	1.0	1.6	1.5	2.2	2.0	1.6	2.0–1.2	2
18	1.2	0.3	1.0	1.3	2.2	.....	1.2	3.1–1.7	2
19	2.0	2.6	1.6	3.5	4.2	.....	2.8	2.9–1.2	2
20	2.0	2.5	2.2	2.3	2.8	3.5	2.6	3.1–1.2	2
21	1.6	2.3	2.0	2.3	2.3	.....	2.1	3.5–1.5	2
22	1.8	1.5	0.8	2.0	3.5	.....	1.9	2.3–0.8	1
23	2.0	2.6	3.3	4.6	3.2	.....	3.1	3.8–1.4	2
24	2.0	2.6	3.2	3.2	3.6	.....	2.9	4.1–2.1	3
25	1.8	1.6	1.8	2.6	2.6	2.0	2.1	3.0–1.2	2

26	1.6	1.0	1.3	1.3	1.6	.....	1.3	2.9–0.8	1
27	1.6	1.0	1.3	1.5	1.6	.....	1.4	5.3–1.8	2
28	1.8	2.6	2.2	3.0	3.6	.....	2.6	3.7–1.3	2
29	2.0	2.5	2.8	2.2	3.2	.....	2.5	4.1–2.1	3
30	2.0	2.6	1.8	2.0	2.8	.....	2.2	6.0–4.3	5
31	2.0	3.0	3.6	4.0	5.3	.....	3.6	5.6–2.5	3
32	2.0	3.0	1.5	2.2	2.8	.....	2.3	4.6–1.6	2
33	2.0	2.6	2.8	2.6	3.5	2.0	2.6	4.1–2.5	3
34	1.6	1.0	1.0	2.0	2.5	2.0	1.7	3.4–1.3	2
35	2.0	2.6	2.5	2.8	3.0	1.5	2.4	3.0–1.9	2
36	1.3	1.3	1.3	1.5	1.6	1.5	1.4	3.4–1.9	2
37	1.5	2.5	2.2	1.8	2.8	3.0	2.3	4.1–1.6	2
38	1.6	2.0	3.0	2.8	2.8	2.5	2.4	5.9–2.0	2
39	2.0	2.6	3.5	4.0	5.5	2.5	3.3	5.9–2.8	3
40	2.0	2.0	2.3	3.3	3.3	3.0	2.6	4.6–2.4	3
41	2.0	3.0	3.6	5.0	5.5	3.5	3.8	3.5–2.1	3
42	1.8	2.6	3.2	5.0	4.6	.....	3.4	4.9–2.5	3
43	2.0	3.0	3.5	4.3	6.0	3.5	3.7	6.5–3.5	4
44	2.0	2.0	1.5	1.6	3.0	.....	2.0	4.7–2.0	2
45	2.0	3.0	3.2	3.3	2.8	2.5	2.8	3.9–2.6	3
46	2.0	3.0	4.0	5.0	4.2	4.5	3.8	4.6–1.9	2
47	2.0	2.5	2.2	4.5	1.8	.....	2.6	6.5–3.3	4
48	2.0	2.6	2.5	4.5	5.3	3.0	3.3	4.1–1.8	2
49	1.2	1.2	0.6	1.5	1.0	3.0	1.4	3.1–1.4	2
50	1.6	2.2	3.3	3.8	5.0	2.5	3.1	5.1–2.1	3
51	1.8	3.0	4.0	4.2	4.8	.....	3.6	4.6–2.1	3
52	2.0	2.6	3.8	3.0	3.8	2.0	2.8	8.2–3.8	4
53	2.0	2.0	4.0	4.2	3.6	2.5	3.0	8.2–3.1	4
54	2.0	3.0	4.0	4.6	4.6	2.5	3.4	8.2–3.4	4
55	2.0	2.6	2.6	3.2	2.6	1.5	2.4	4.1–2.4	3
56	2.0	2.6	3.2	4.3	3.6	4.0	3.3	6.8–3.3	4
57	2.0	2.3	3.6	5.0	5.0	3.3	3.5	10.0–3.6	4
58	2.0	3.0	4.0	5.0	6.0	3.5	3.9	6.8–3.1	4
59	2.0	3.0	2.8	4.0	4.2	3.0	3.1	6.0–2.8	3

the tests and experiments discussed in the two preceding chapters. The figures in the first column indicate the number of words exposed. In each case there were three exposures. Thus there were three exposures with two words each, three with three words each, etc. It is very apparent that W. E. is much superior to B. R. in this test.

Table XLVIII gives the results in this test for all subjects. A number of subjects were not tested on the seven-word sentences, as indicated by the blanks in the table. The vertical column next to the last shows for purposes of comparison the silent-reading rate when questions are to be answered on prose passages (chapter ii, Table XI).

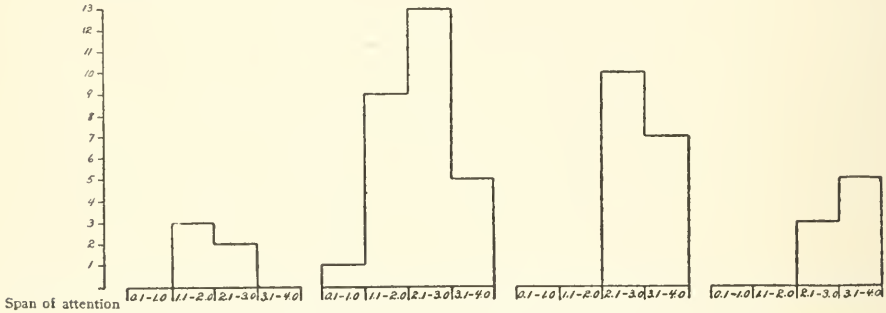


DIAGRAM 6.—Relation between span of attention and rate of reading

In order to show the relation which exists between span of attention and rate of reading, the results for Table XLVIII have been brought together in Diagram 6 in the form of distribution curves. The subjects were divided into four minimum-rate groups, and the individuals in each group were distributed in accordance with their average span of attention. A study of the diagram shows clearly that, as the rate of reading increases, the span of attention increases. In this connection note that in Group I a span of attention not greater than 2 predominates, that in Group II a span which ranges from 2.1 to 3 predominates, and that the same type of increase in the length of the span holds for Groups III and IV.

The relation which exists between span of attention and number of pauses per line is of interest at this point. This relation is shown

in Table XLIX. The numbers of pauses are taken from Table XXXVIII in the preceding chapter, while the average span of attention given is taken from Table L. Only the third grade and

TABLE XLIX

Relation between Span of Attention and Number of Pauses per Line

Grade	Subject	No. of Pauses per Line	Average Span	Grade	Subject	No. of Pauses per Line	Average Span
3.....	1	13.8	0.7	C.....	52	5.1	2.8
	2	7.9	2.8		53	8.8	3.0
	3	9.2	2.9		54	5.0	3.4
	4	6.2	2.5		55	8.4	2.4
	6	7.3	2.2		56	7.6	3.3
	7	7.1	2.6		57	5.2	3.5
	8	14.0	1.5		58	6.8	3.9
	9	14.5	1.3		59	8.2	3.1

college group have been used, but they show that the reader does not make use of his full span of attention, for there is a large amount of overlapping of the different fields of attention. Take the case of subject No. 58, who made 6.8 pauses in a seven- to ten-word line. With a span of attention of 3.9 words, she should have read the line with about 3.0 instead of 6.8 pauses. Further discussion will show the importance of such overlapping and that it can be reduced by training.

A second perception test consisted in cutting off the projected reading matter while the subject was in the midst of a passage. He was asked to keep on reading as far as possible beyond the point at which the selection was cut off. Of the eight graded selections, each one was cut off three times—at the beginning of a line, in the middle, and at the end of a line. A dictaphone was used in connection with the apparatus, for projecting the passage. The subject read into the dictaphone, and a bell sounded simultaneously with the closing of the shutter.

Tables L and LI give the results in this test for B. R. and W. E. Again the advantage is with W. E. Tables LII, LIII, and LIV give the results for all subjects. The oral-reading rates indicated in the vertical column next to the last are taken from Table V on page 22. Certain words were given half-credit as indicated in

TABLE L

RECORD OF B. R. IN SECOND PERCEPTION TEST

	Selection	No. of Words Reported	No. of Words Incorrect	No. of Words Correct
Beginning of the line.	1	4	0	4
	2	3	0	3
	3	3	1	2
	4	2	0	2
	5	5	0	5
	6	4	0	4
	7	2	0	2
	8	2	0	2
				24
				Average = 3.0
Middle of the line...	1	2	0	2
	2	2	0	2
	3	1	0	1
	4	2	0	2
	5	0	.....	.....
	6	2	0	2
	7	5	0	5
	8	2	0	2
				16
				Average = 2.0
End of the line.....	1	0	.....	.....
	2	2	0	2
	3	3	0	3
	4	4	0	4
	5	2	0	2
	6	2	0	2
	7	2	0	2
	8	2	0	2
				17
				Average = 2.1

the column for correct words. The same words are scored as incorrect in the column for incorrect words.

In order to bring out the relation which exists between the rate of reading and the results of the present test, certain results in Table LII have been put in the form of distribution curves (Diagram 7). The subjects were grouped on the basis of minimum rate for oral reading, Group 1 including all subjects whose minimum rate was 0.1–1.0 word per second; Group 2, 1.1–2.0 words; etc. The group to which any individual belongs is indicated in the last column of Table LII. The base line of the diagram indicates the number of words that can be read after the exposure is ended. The digits at the left indicate the number of subjects.

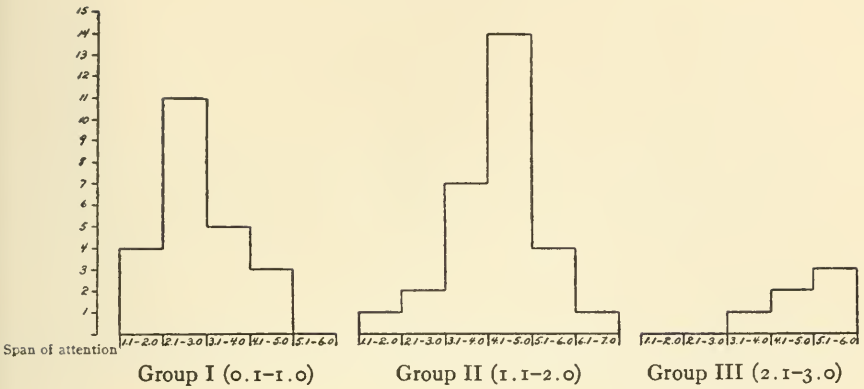


DIAGRAM 7.—Relation between range of recognition and rate of reading

TABLE LI

RECORD OF W. E. IN SECOND PERCEPTION TEST

	Selection	No. of Words Reported	No. of Words Incorrect	No. of Words Correct
Beginning of the line.	1	4	0	4
	2	4	0	4
	3	5	0	5
	4	7	0	7
	5	7	0	7
	6	6	1	5
	7	3	0	3
	8	5	0	5
				40
				Average = 5.0
Middle of the line...	1	2	0	2
	2	3	0	3
	3	5	0	5
	4	4	0	4
	5	5	0	5
	6	4	0	4
	7	6	0	6
	8	3	0	3
				32
				Average = 4.0
End of the line.....	1	7	0	7
	2	4	0	4
	3	5	0	5
	4	7	0	7
	5	2	0	2
	6	6	2	4
	7	3	0	3
	8	3	0	3
				35
				Average = 4.3

TABLE LII

RECORD OF ALL SUBJECTS FOR RANGE OF RECOGNITION AT THE BEGINNING OF A LINE

Grade	Subject	No. of Selections	No. of Words Reported	No. of Words Incorrect	No. of Words Correct	Average No. of Correct Words per Line	Oral Rate	Minimum-Rate Group
3	1	3	8	0	8	2.6	2.5–0.8	1
	2	4	19	0	19	4.7	3.3–1.5	2
	3	5	18	1	17	3.4	4.8–1.3	2
	4	5	26	3	23	4.6	3.4–1.2	2
	5	3	8	2	6	2.0	2.3–1.1	2
	6	3	10	0	10	3.3	2.7–1.3	2
	7	5	28	4	24	4.8	2.9–1.8	2
	8	4	9	1	8	2.0	1.7–0.8	1
	9	3	7	0	7	2.3	2.7–1.3	2
4	10	8	28	1	27.5	3.4	3.8–1.2	2
	11	8	28	0	28	3.5	4.3–1.4	2
	12	8	23	0	23	2.8	3.7–0.8	1
	13	8	15	0	15	1.9	2.8–0.6	1
	14	8	16	0	16	2.0	2.9–0.8	1
	15	8	21	0	21	2.6	2.6–0.7	1
	16	5	19	1	18.5	3.7	3.2–1.0	1
	17	6	22	1	21	3.5	2.7–0.8	1
5	18	7	14	0	14	2.0	3.8–1.0	1
	19	6	14	0	14	2.3	3.1–0.6	1
	20	7	23	0	23	3.3	3.3–1.3	2
	21	4	17	0	17	4.2	4.8–1.0	1
	22	8	34	1	33	4.1	3.5–1.2	2
	23	8	24	0	24	3.0	4.3–1.0	1
	24	7	32	0	32	4.5	3.8–0.9	1
	25	8	21	0	21	2.6	3.2–0.7	1

6	26	8	25	1	24	3.0	3.2–0.6	1
	27	8	39	0	39	4.8	3.7–1.3	2
	28	8	33	3	30	3.7	3.8–0.9	1
	29	6	24	0	24	4.0	3.7–1.3	2
	30	8	36	0	36	4.5	3.7–1.7	2
	31	8	41	1	40.5	5.0	4.6–1.6	2
	32	8	24	0	24	3.0	3.4–1.1	2
7	33	8	38	2	36	4.5	3.9–1.3	2
	34	6	24	0	24	4.0	3.5–1.0	1
	35	8	38	0	38	4.7	3.7–0.8	1
	36	7	21	0	21	3.0	3.7–0.9	1
	37	8	28	0	28	3.5	4.6–1.0	1
	38	8	21	1	20	2.5	3.6–0.9	1
	39	8	37	1	36.5	4.5	4.3–1.3	2
	40	6	33	1	32	6.4	4.1–1.7	2
	41	8	45	1	44.5	5.5	4.1–1.6	2
H.S.	42	6	31	0	31	5.1	5.2–2.4	3
	43	.....	.....	Record lost	.....	.....	4.1–2.2	3
	44	8	21.5	0	21.5	2.7	3.7–0.9	1
	45	8	45	0	45	5.6	4.8–1.8	2
	46	7	31	0	31	4.4	5.4–2.2	3
	47	6	34	1	33	5.5	4.3–1.9	2
	48	7	35	0	35	5.0	4.6–1.7	2
	49	4	12	0	12	3.0	3.7–1.0	1
	50	8	47	1	46	5.7	5.3–2.1	3
	51	8	39	0	39	4.8	4.4–1.6	2
C	52	5	24	0	24	4.8	5.4–1.9	2
	53	8	47	0	47	6.0	4.8–2.2	3
	54	6	29	0	29	4.8	4.5–1.8	2
	55	8	32	0	32	4.0	4.0–2.1	3
	56	7	31	0	31	3.8	4.8–1.7	2
	57	6	29	1	28	4.6	4.9–2.1	3
	58	8	42	0	42	5.2	4.1–1.9	2
	59	8	40	1	39	4.8	5.0–1.3	2

TABLE LIII

RECORD OF ALL SUBJECTS FOR RANGE OF RECOGNITION AT THE MIDDLE OF A LINE

Grade	Subject	No. of Selections	No. of Words Reported	No. of Words Incorrect	No. of Words Correct	Average No. of Correct Words per Line	Oral Rate	Silent Rate
3	1	3	3	0	3	1.0	2.5–0.8	3.1–1.3
	2	3	10	0	10	3.3	3.3–1.5	4.5–2.5
	3	6	24	0	24	4.0	4.8–1.3	3.6–2.1
	4	5	18	3	15.5	3.1	3.4–1.2	4.1–2.2
	5	4	7	0	7	1.7	2.3–1.1	1.9–1.5
	6	4	15	0	15	3.7	2.7–1.3	3.3–1.9
	7	5	31	8	23.5	4.7	2.9–1.8	5.8–2.5
	8	4	8	0	8	2.0	1.7–0.8	1.9–0.8
	9	3	4	1	3	1.0	2.7–1.3	2.5–1.9
4	10	8	32	1	31	3.8	3.8–1.2	3.1–1.7
	11	8	22	2	20	2.5	4.3–1.4	2.7–1.6
	12	8	19	2	17.5	2.2	3.7–0.8	3.0–1.6
	13	8	15	0	15	1.9	2.8–0.6	2.4–1.3
	14	8	16	0	16	2.0	2.9–0.8	3.4–1.5
	15	8	13	0	13	1.6	2.6–0.7	2.2–1.0
	16	5	15	1	14	2.8	3.2–1.0	2.9–0.9
	17	6	15	1	14	2.3	2.7–0.8	2.0–1.2
5	18	8	22	1	21	2.6	3.8–1.0	3.1–1.7
	19	6	11	0	11	1.8	3.1–0.6	2.9–1.2
	20	8	21	0	21	2.6	3.3–1.3	3.1–1.2
	21	7	22	0	22	3.1	4.8–1.0	3.5–1.5
	22	7	22	0	22	3.1	3.5–1.2	2.3–0.8
	23	8	20	0	20	2.5	4.3–1.0	3.8–1.4
	24	8	26	0	26	3.2	3.8–0.9	4.1–2.1
	25	8	25	2	23	2.8	3.2–0.7	3.0–1.2

	26	8	16	0	16	2.0	3.2–0.6	2.9–0.8
	27	8	25	2	23	2.8	3.7–1.3	5.3–1.8
	28	8	28.5	1	27.5	3.4	3.8–0.9	3.7–1.3
6	29	7	26	0	26	3.7	3.7–1.3	4.1–2.1
	30	8	27	0	27	3.3	3.7–1.7	6.0–4.3
	31	8	32	0	32	4.0	4.6–1.6	5.6–2.5
	32	8	22	1	21	2.6	3.4–1.1	4.6–1.6
	33	8	27	0	27	3.4	3.9–1.3	4.1–2.5
	34	6	20	0	20	3.3	3.5–1.0	3.4–1.3
	35	8	25	1	24.5	3.5	3.7–0.8	3.0–1.9
	36	8	19	0	19	2.4	3.7–0.9	3.4–1.9
7	37	7	29	0	29	4.1	4.6–1.0	4.1–1.6
	38	6	15	0	15	2.5	3.6–0.9	5.9–2.0
	39	8	34	0	34	4.2	4.3–1.3	5.9–2.8
	40	8	44	3	41	5.1	4.1–1.7	4.6–2.4
	41	7	29	2	27	3.8	4.1–1.6	3.5–2.1
	42	7	33	0	33	4.7	5.2–2.4	4.9–2.5
	43	.....	.....	Record lost	.....	.....	4.1–2.2	6.5–3.5
	44	8	23	0	23	2.9	3.7–0.9	4.7–2.0
	45	8	51	1	50	6.2	4.8–1.8	3.9–2.6
	46	7	38	0	38	5.4	5.4–2.2	4.6–1.9
H.S.	47	4	22	0	22	5.5	4.3–1.9	6.5–3.3
	48	8	33	0	33	4.1	4.6–1.7	4.1–1.8
	49	5	11	0	11	2.2	3.7–1.0	3.1–1.4
	50	7	37	0	37	5.2	5.3–2.1	5.1–2.1
	51	8	36	1	35	4.3	4.4–1.6	4.6–2.1
	52	7	30	0	30	4.3	5.4–1.9	8.2–3.8
	53	7	30	0	30	4.3	4.8–2.2	8.2–3.1
	54	8	36	0	36	4.7	4.5–1.8	8.2–3.4
C	55	8	23	0	23	2.8	4.0–2.1	4.1–2.4
	56	7	34	0	34	4.8	4.8–1.7	6.8–3.3
	57	5	24	0	24	4.8	4.9–2.1	10.0–3.6
	58	8	42	4	38	4.8	4.1–1.9	6.8–3.1
	59	6	28	0	28	4.6	5.0–1.3	6.0–2.8

TABLE LIV

RECORD OF ALL SUBJECTS FOR RANGE OF RECOGNITION AT THE END OF A LINE

Grade	Subject	No. of Selections	No. of Words Reported	No. of Words Incorrect	No. of Words Correct	Average No. of Correct Words per Line	Oral Rate	Silent Rate
3	1	4	8	1	7	1.7	2.5–0.8	3.1–1.3
	2	4	18	0	18	4.5	3.3–1.5	4.5–2.5
	3	6	20	0	20	3.3	4.8–1.3	3.6–2.1
	4	5	24	6	19.5	3.9	3.4–1.2	4.1–2.2
	5	4	10	2	8.5	2.1	2.3–1.1	1.9–1.5
	6	4	12	0	12	3.0	2.7–1.3	3.3–1.9
	7	5	27	3	24	4.8	2.9–1.8	5.8–2.5
	8	4	7	1	6	1.5	1.7–0.8	1.9–0.8
	9	4	5	0	5	1.2	2.7–1.3	2.5–1.9
4	10	8	28	5	23.5	2.9	3.8–1.2	3.1–1.7
	11	8	28	1	27	3.3	4.3–1.4	2.7–1.6
	12	8	18	3	15.5	1.9	3.7–0.8	3.0–1.6
	13	8	10	0	10	1.3	2.8–0.6	2.4–1.3
	14	8	11	2	9.5	1.2	2.9–0.8	3.4–1.5
	15	8	13	0	13	1.6	2.6–0.7	2.2–1.0
	16	4	13	1	12	3.0	3.2–1.0	2.9–0.9
	17	6	11	0	11	1.8	2.7–0.8	2.0–1.2
5	18	7	13	1	12	1.7	3.8–1.0	3.1–1.7
	19	8	19	0	19	2.3	3.1–0.6	2.9–1.2
	20	7	15	0	15	2.1	3.3–1.3	3.1–1.2
	21	5	15	0	15	3.0	4.8–1.0	3.5–1.5
	22	8	26	0	26	3.2	3.5–1.2	2.3–0.8
	23	7	19	0	19	2.7	4.3–1.0	3.8–1.4
	24	8	29	0	29	3.6	3.8–0.9	4.1–2.1
	25	8	22	1	21	2.6	3.2–0.7	3.0–1.2

	26	8	17	0	17	2.1	3.2–0.6	2.9–0.8
	27	7	28	4	24.5	3.5	3.7–1.3	5.3–1.8
	28	8	31	4	27.5	3.4	3.8–0.9	3.7–1.3
6	29	8	23	2	21.5	2.7	3.7–1.3	4.1–3.1
	30	8	27	0	27	3.3	3.7–1.7	6.0–4.3
	31	8	37	2	35	4.4	4.6–1.6	5.6–2.5
	32	8	26	2	24	3.0	3.4–1.1	4.6–1.6
	33	8	29	1	28	3.5	3.9–1.3	4.1–2.5
	34	7	18	0	18	2.5	3.5–1.0	3.4–1.3
	35	7	24	2	22	3.2	3.7–0.8	3.0–1.9
	36	8	22	0	22	2.7	3.7–0.9	3.4–1.9
7	37	8	22	0	22	2.7	4.6–1.0	4.1–1.6
	38	8	25	1	24.5	3.0	3.6–0.9	5.9–2.0
	39	8	38	1	37	4.6	4.3–1.3	5.9–2.9
	40	7	37	1	36.5	5.2	4.1–1.7	4.6–2.4
	41	8	41	1	40	5.0	4.1–1.6	3.5–2.1
	42	7	38	1	37.5	5.3	5.2–2.4	4.9–2.5
	43	.....	.....	Record lost	.....	.....	4.1–2.2	6.5–3.5
	44	7	22	0	22	3.1	3.7–0.9	4.7–2.0
	45	7	37	0	37	5.2	4.8–1.8	3.9–2.6
H.S.	46	7	31	0	31	4.4	5.4–2.2	4.6–1.9
	47	5	25	1	24	4.8	4.3–1.9	6.5–3.3
	48	8	38	1	37	4.6	4.6–1.7	4.1–1.8
	49	4	7	0	7	1.7	3.7–1.0	3.1–1.4
	50	7	41	0	41	5.8	5.3–2.1	5.1–2.1
	51	8	38	1	37	4.6	4.4–1.6	4.6–2.1
	52	4	19	0	19	4.7	5.4–1.9	8.2–3.8
	53	8	30	2	28	4.0	4.8–2.2	8.2–3.1
	54	8	33	0	33	4.1	4.5–1.8	8.2–3.4
C	55	7	23	0	23	3.3	4.0–2.1	4.1–2.4
	56	8	34	0	34	4.2	4.8–1.7	6.8–3.3
	57	6	25	0	25	4.1	4.9–2.1	10.0–3.6
	58	7	34	3	31	4.4	4.1–1.9	6.8–3.1
	59	7	33	1	32.5	4.6	5.0–1.3	6.0–2.8

A study of the diagram shows clearly that, as the rate of reading increases, the range of recognition increases. In Group 1 the range of recognition within the limits of 1.1–2.0 words predominates; in Group 2 the range of 4.1–5.0 words predominates, and in Group 3 a range between the limits of 5.1–6.0 words predominates.

It is of interest also to note the average range for various parts of the line as reported in Tables LII, LIII, and LIV. The average range at the beginning of the line is 3.8 words; at the middle and the end of the line, 3.3 words. The greater range at the beginning of the line is probably due to the fact that it is possible for the attention to spread over the entire line, while in the other cases the longer range is not possible without the attention passing to the next line.

Table LV gives the average range for successive grades. A survey of this table shows that the fourth and fifth grades do not have results which equal the third grade. From the fifth grade

TABLE LV

AVERAGE RANGE OF RECOGNITION FOR SUCCESSIVE SCHOOL GRADES

GRADE	AVERAGE NO. OF CORRECT WORDS TO THE LINE		
	Beginning	Middle	End
3	3.3	2.7	2.9
4	2.9	2.4	2.1
5	3.2	2.7	2.6
6	4.0	3.1	3.2
7	4.3	3.6	3.6
H.S.	4.6	4.5	4.4
C.	4.7	4.4	4.2

there is an increase in the range through the various grades until the college group is reached, when the results for the middle of the line and the end of the line are not as great as the same results for the high-school group. The results for the fourth and fifth grades are very interesting. The smaller range in these grades is probably due to the fact that the children are in a transition period in their training in reading. That is, the fourth and fifth grades are the stages in school life at which the child begins to change his mode

of reading. When he is called on at this stage to read aloud, his attention may be distracted, so that he does less well than he would at either an earlier or a later stage. The very small difference between the high-school and college groups is probably due to the fact that the high-school group has about reached the limit in such development, and the differences between the groups may be thought of as individual differences.

Further perception data were procured by using the same type of test in silent reading. In this test the reading material was projected before the subject, as indicated on page 89. It will be remembered that the reading material can be made to disappear from the view of the reader by means of a photographic shutter which is mounted upon the projecting lantern. The subjects were told that the exact point must be noted where the attention was focused when the material disappeared, and that the amount of the reading material retained beyond that point must be written down. The eyes of the subjects were in view of the experimenter, and an attempt was made to cut off the light at about the fifth line, but this attempt did not always succeed. As this test was considered too complicated for children, it was given only to the college group. In Table LVI the contrast between the results in the present test for No. 55, who is a very slow reader, and the results for more rapid readers, such as Nos. 54 and 57, indicates clearly that the fast silent reader is one whose attention spreads over a considerable range of material.

TABLE LVI

RANGE OF RECOGNITION IN SILENT READING FOR ADULTS

Subject	Average No. of Words per Line	Silent-Reading Rate	Subject	Average No. of Words per Line	Silent-Reading Rate
52.....	3.1	8.2–3.8	56.....	2.5	6.8–3.3
53.....	3.9	8.2–3.1	57.....	3.1	10.0–3.6
54.....	2.7	8.2–3.4	58.....	2.7	6.8–3.1
55.....	1.1	4.1–2.4	59.....	2.0	6.0–2.8

The fact that the fast reader has a long span of attention has been fully established by the foregoing paragraphs. The meaning of these facts is probably something like this: As the reader looks

at a point on the line, he sees some elements clearly and some vaguely. The next fixation brings into clear perception elements of the line which a moment before were perceived vaguely. There is an overlapping of spans of attention, and the expert reader is able to take advantage, more completely than the poor reader, of a wide range of experience which lies outside the immediate center of attention.

The question of what produces differences in span of attention is one which invites consideration. Doubtless these differences are in some cases due to inherent differences in the organization of the nervous system. Sometimes the differences are due to the kind of training which the individual has had in reading. There are also general differences, such as that of the level of attention at which a subject works, and of the familiarity with language forms.

In order to get data on these various points, further short-exposure experiments were carried out. In the first group of experiments non-sense syllables, digits, and groups of the same digit were exposed to view, instead of the sentences used in the experiments just described. In obtaining these results a type of apparatus was used which differs from that used in the preceding work on perception. This apparatus may be described briefly as a camera with ground glass at *A* (Fig. 8) and an eyeshield at *B*. The letters at which the subject is to look are focused on *A* by a lens mounted in the lens board *C*. Back of this lens board is a chamber, not shown in the drawing, with four nitrogen lamps of 100 watts each. When these lamps are turned on and the light is allowed to come through the lens and fall on *A*, a focused image of any letters placed before the lens in the lighted chamber will be seen. The actual exposure of letters and figures on *A* is controlled by the camera shutter mounted on the lens. The lens carries on the side nearer to *A* four small short-filament lamps. These lamps are intended to keep the glass *A* illuminated when the shutter is closed. The subject is in this way provided at all times with an illuminated field. In the small figure at the right of Fig. 8 the details of the shutter are shown. As the shutter begins to open, it breaks an electric circuit at *E* and turns off the small lights *D* at

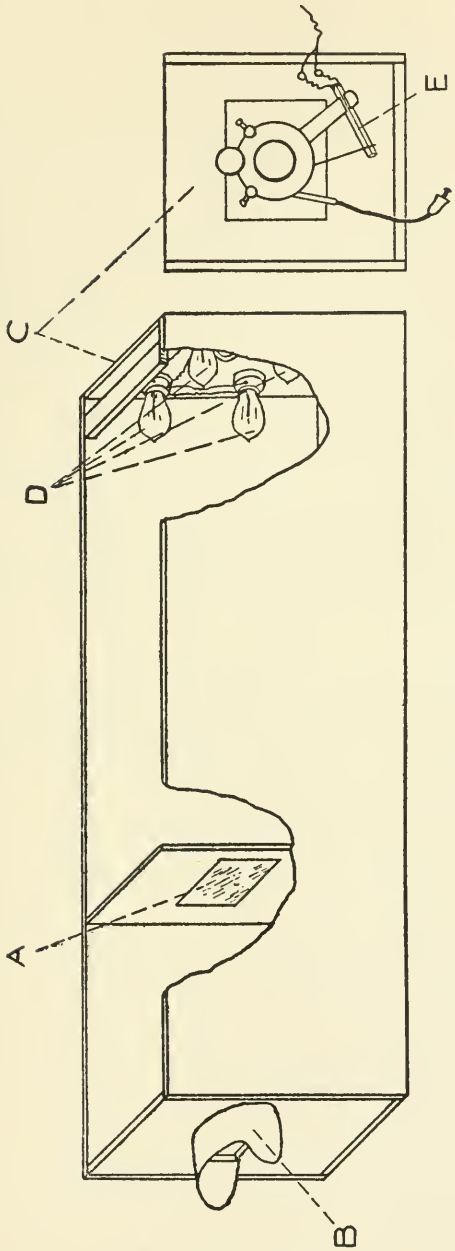


FIG. 8.—Short-exposure apparatus

A—Ground glass
B—Eye shield
C—Lens board
D—Light bulbs
E—Point on shutter where circuit is broken

the same time that it allows light to come from the box back of the lens. There is thus a continuous light field at *A;* sometimes this field is an uninterrupted blank, the light coming from the lamps *D;* sometimes it is an image of letters from the box behind the lens. The shutter exposes the letters for nine-fiftieths of a second. It was tested repeatedly for regularity and proved very satisfactory.

Tables LVII and LVIII give the results for non-sense material and digits for fourteen individuals. With the exception of No. 29 and No. 30, who have replaced No. 26 and No. 31, they are the same as the members of the group of fourteen which has been referred to in previous tests. In scoring the results credit was given only for those digits or letters which were absolutely correct. The column in parentheses gives the results for the first perception test.

An examination of these results shows clearly that the differences between good and poor readers are much less striking for perception of digits or the non-sense material than for the type of materials used in the preceding perception tests. The differences are less marked in the case of the digits than in the case of non-sense syllables.

For the next test zeros were arranged in groups of three, four, five, six, or seven. Sample groups of these arrangements are presented in the Appendix, page 172. The perception here required is not of individual digits, for each digit is like every other. The group form is what is seen and recognized.

The results of this test are in Table LIX. The first column indicates the different series and the number of zeros in each exposure. The exposure time was the same as in other perception tests, and the order of poor and good readers is the same as that in the preceding tables. "R" indicates a correct response, a dash an incorrect response, on the part of the subject. Little, if any, relation is shown between the ability required in this test and reading ability, for certain of the poor readers have a greater span than the good, while in other cases the opposite is true.

In addition to the tests for perception thus far described two *Aussage* tests were given. The pictures used were those of the butcher and the carpenters. The pictures were exposed to the view of the subject for ten seconds. Tables LX and LXI give no

TABLE LVII

PERCEPTION RECORDS OF FOURTEEN INDIVIDUALS WITH DIGITS

Grade	Subject	Reading Ability	No. of Digits Exposed	No. of Digits Reported	No. of Digits Incorrect	Perceptual Span	Average No. of Digits per Line	Percentage Correct
3	1	P	81	66	23	(0.7)	2.38	44.4
	7	G	81	56	17	(2.6)	2.16	39.1
4	17	P	81	66	4	(1.6)	3.40	67.5
	10	G	81	59	0	(2.7)	3.27	64.6
5	19	P	81	53	2	(2.8)	2.80	58.8
	24	G	81	38	1	(2.9)	2.05	45.6
6	29	P	81	63	11	(2.5)	2.90	58.4
	30	G	81	40	5	(2.2)	2.00	41.1
7	36	P	81	52	0	(1.4)	2.88	63.4
	41	G	81	59	4	(3.8)	3.00	59.2
H.S.	49	P	81	58	6	(1.4)	2.88	58.4
	45	G	81	51	0	(2.8)	2.80	57.2
C.	56	P	81	60	4	(3.3)	3.10	65.4
	54	G	81	72	4	(3.4)	3.70	78.6

TABLE LVIII

PERCEPTION RECORDS OF FOURTEEN INDIVIDUALS WITH NON-SENSE MATERIAL

Grade	Subject	Reading Ability	No. of Letters Exposed	No. of Letters Reported	No. of Letters Incorrect	Perceptual Span	Average No. of Letters per Line	Percentage Correct
3	1	P	81	63	29	(0.7)	1.88	37.4
	7	G	81	62	25	(2.6)	2.00	39.5
4	17	P	81	56	8	(1.6)	2.66	52.6
	10	G	81	45	6	(2.7)	2.16	44.8
5	19	P	81	46	4	(2.8)	2.30	46.9
	24	G	81	34	1	(2.9)	1.80	39.9
6	29	P	81	55	17	(2.5)	2.10	43.2
	30	G	81	50	1	(2.2)	2.70	58.8
7	36	P	81	37	9	(1.4)	1.50	30.0
	41	G	81	58	5	(3.8)	2.90	60.1
H.S.	49	P	81	47	6	(1.4)	2.27	46.5
	45	G	81	46	4	(2.8)	2.30	49.8
C.	56	P	81	37	3	(3.3)	1.90	40.3
	54	G	81	59	4	(3.4)	3.00	61.7

TABLE LIX

PERCEPTION RECORDS OF FOURTEEN INDIVIDUALS WITH DIFFERENT ARRANGEMENTS OF ZERO

Subject	1	7	17	10	19	24	29	30	36	41	49	45	56	54
Series I														
3	R	R	R	R	R	R	R	R	R	R	R	R	R	R
4	—	R	R	—	R	R	—	R	R	R	R	R	R	R
5	R	—	—	—	—	—	R	R	R	—	R	R	R	R
6	—	—	R	—	—	—	—	—	—	R	—	—	R	R
7	—	—	—	R	—	—	—	—	—	—	—	R	—	—
Series II														
6	R	—	R	R	R	—	—	—	R	R	—	R	R	R
9	R	R	—	—	R	R	R	R	—	R	—	R	R	R
12	—	R	R	—	R	—	—	R	—	—	—	R	R	R
Series III														
8	R	—	—	—	R	—	—	R	—	R	—	—	R	R
12	—	—	—	—	R	—	—	—	—	R	—	—	R	R
16	—	—	—	—	R	—	—	R	—	—	—	—	—	R
Series IV														
6	—	R	R	R	R	—	R	R	R	—	R	R	R	R
9	—	R	—	—	R	—	—	—	R	—	R	—	R	R
12	—	R	—	—	R	—	—	—	R	R	—	—	R	—
15	—	R	—	—	R	R	R	—	—	—	R	—	R	—
Series V														
8	—	—	R	—	R	R	R	R	—	R	R	R	R	R
12	—	—	—	—	R	R	—	—	R	—	—	R	—	R
16	—	—	—	—	R	—	—	R	—	—	—	—	R	R
20	—	—	—	—	R	—	—	—	—	—	—	—	—	—
Series VI														
10	—	—	R	—	—	—	R	R	R	R	R	R	R	R
15	—	—	—	—	—	R	—	—	—	—	—	R	R	R
20	—	R	—	—	—	—	—	—	—	—	—	—	R	R
25	—	R	—	—	—	—	—	—	—	—	—	—	—	R
Series VII														
12	R	—	—	R	—	—	—	R	—	R	—	R	R	R
18	—	—	—	—	—	R	—	—	—	—	—	—	—	R
24	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30	—	—	R	—	—	—	—	—	—	—	—	—	—	R
Series VIII														
14	—	—	—	—	R	—	—	R	—	R	—	—	—	R
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—
28	—	—	—	—	R	—	—	—	—	—	—	—	—	—
35	—	—	—	—	—	R	—	—	—	—	—	—	—	—
Total rights	6	10	9	5	18	9	7	13	9	12	8	13	10	22

TABLE LX

RECORDS OF FOURTEEN INDIVIDUALS IN FIRST AUSSAGE TEST

Grade	Subject	Reading Ability	No. of Objects Reported	No. of Objects Correct	Writing Time
3	1	P	10	9	.....
	7	G	10	9	2:20
4	17	P	6	6	1:29
	10	G	13	9	1:57
5	19	P	12	9	2:19
	24	G	8	8	0:54
6	26	P	11	10	1:34
	31	G	13	12	.....
7	36	P	11	9	0:55
	41	G	9	9	1:42
H.S.	49	P	8	8	1:06
	45	G	16	16	1:57
C.	56	P	11	11	0:53
	54	G	13	10	0:34

TABLE LXI

RECORDS OF FOURTEEN INDIVIDUALS IN SECOND AUSSAGE TEST

Grade	Subject	Reading Ability	No. of Objects Reported	No. of Objects Correct	Writing Time
3	1	P	5	4	.....
	7	G	7	7	2:32
4	17	P	5	4	1:06
	10	G	10	8	1:40
5	19	P	9	8	1:12
	24	G	7	7	0:50
6	26	P	7	7	1:05
	31	G	8	7	0:40
7	36	P	7	7	1:05
	41	G	10	9	1:27
H.S.	49	P	8	6	1:01
	45	G	8	7	1:00
C.	56	P	8	7	0:40
	54	G	12	12	0:32

evidence of a relation between the results of such a test and reading ability.

We may now return to a discussion of the factors which were suggested as making for differences in the span of attention as seen in efficient individuals.

From the experiments which have just been cited it is clear that the differences between good and poor readers which appeared when meaningful material was used disappeared in large measure when non-sense syllables, digits, groups of the same digit, and the *Aussage* tests were used. This seems to prove that the inherent differences in mental capacity which exist between members in this group are not the causes of differences in span of attention. It appears rather that differences in training—that is, acquired abilities to deal with meanings—are the source of differences in perceptual span.

If the crucial matter were differences in general familiarity with language forms, it would be difficult to explain the large differences found within the high-school and college groups, in which the training has been sufficient to produce great familiarity with the simple material which was used in all the tests. General familiarity with language may play some part in the lower grades, but certainly not in the upper grades.

The influence which we are compelled to recognize as most important in producing differences in the visual span is the type of training which is gained in reading. Certainly the slow reading which proceeds word by word and which emphasizes small units of thought is a type of training which makes for a small span of attention. Later discussion will show the advisability of more intensive training in perception for lower-grade children. It is true that primary teachers do give training in perception by means of the so-called "flash cards," but such work should be extended and more adequately controlled. It probably will be desirable to go so far as to provide some simple form of apparatus which will enable the teacher to control the time of exposure. In addition to this the child should be encouraged in rapid silent reading, and every plan which makes for grasping the thought in large units should be used by the teachers.

In the introductory review of investigations which have dealt with perception as it relates to the problems in reading, reference was made to Ruediger's test for distinct vision. Since Ruediger's subjects were adults, it seemed worth while to try the same type of test with children. Cards were prepared with a point of fixation in the center and either the letter *u* or *n* in twelve-point type printed either at the right or at the left of this point of fixation. On some of the cards the letter was on the right, on others on the left, of the

TABLE LXII

RECORDS OF FOURTEEN INDIVIDUALS IN DISTINCT-VISION TEST

Grade	Subject	Reading Ability	10 mm.	15 mm.	20 mm.	25 mm.	30 mm.	35 mm.	40 mm.	45 mm.	50 mm
3	1	P	3	6	4	4	2	2	0	4	3
	7	G	5	5	6	1	4	3	3	5	4
4	17	P	8	7	5	5	5	5	5	2	2
	10	G	7	7	8	7	6	5	7	7	4
5	19	P	7	6	8	7	7	7	7	4	5
	24	G	6	6	7	3	5	5	2	4	2
6	26	P	7	6	6	5	7	6	6	7	4
	31	G	8	5	5	5	4	3	4	5	2
7	36	P	8	7	8	6	7	4	4	8	4
	41	G	8	5	8	5	5	7	6	6	5
H.S.	49	P	8	7	7	7	4	4	6	5	3
	45	G	5	6	5	5	5	4	3	6	4
C	56	P	8	6	7	8	6	6	7	7	4
	54	G	8	7	8	8	8	8	8	7	5

point of fixation. The letters were at different distances from the fixation point: 10, 15, 20, 25, 30, 35, 40, 45, and 50 millimeters. The test consists in exposing the card for a brief interval. The observer must then determine, while fixating the central point, whether the letter is an *n* or a *u*.

Table LXI gives the number of right answers under each condition, eight exposures being given for each distance. The following points may be noted:

1. If the records of the poor readers are compared with the records of the good readers in the same grade, it will be found that

in the fifth and sixth grades and in the high school the poor readers do better in this test than do the good readers.

2. The fourth grade does better in this test than does the third grade. From this point there seems to be no great difference in the results for the various grades.

3. In general it may be said that the distances at which 75 per cent of the judgments are correct is greater than in Ruediger's tests. This is probably due to the fact that the time allowed for the exposure in this test was much greater than in Ruediger's work.

4. The conclusion to be reached is the same as that found by Ruediger—namely, that there is no relation between span of distinct vision and rate of reading; in other words, differences in rate of reading are not due to physiological differences in the retina.

SUMMARY OF THE CHAPTER

1. There is a close relation between the rate of reading and the span of attention as shown in the tests where meaningful material is used.

2. The differences between the span of attention of the good and poor reader disappear in a very large measure when non-sense syllables, digits, groups of the same digit, or the *Aussage* test are given.

3. Little difference is seen in the two types of readers when a distinct-vision test is given.

4. Large differences in the span of attention do not seem to be inherent and are probably produced by the type of training given by the school.

CHAPTER V

EFFECT OF PRACTICE UPON CERTAIN DIFFICULTIES IN READING

The practical school problem suggested by the preceding chapters is the development of methods and devices whereby the efficiency of the poor reader can be increased. A list of possible experimental types of training follows:

1. Training in oral reading to reduce—
   a) Mispronunciations
   b) Omissions
   c) Insertions
   d) Substitutions
   e) Repetitions
2. Training to promote efficiency in various phases of oral reading, such as—
   a) Poise
   b) Pitch
   c) Articulation
   d) Pronunciation
   e) Emphasis
   f) Force
   g) Interpretation
   h) Inflection
3. Training in rapid vocalization
4. Training in rapid silent reading
5. Training in silent reading for the purpose of—
   a) Answering questions orally
   b) Answering questions in writing
   c) Oral reproduction
   d) Written reproduction
   e) Outlining
6. Training in breathing as it relates to oral reading
7. Training for the purpose of reducing vocalization in silent reading
8. Training for the purpose of increasing perceptual span
9. Training in eye-movements

This list is not exhaustive nor is it thought that any one individual needs training in all of these lines, but there are individuals

who would be benefited by each of the types of training which have been catalogued above.

TABLE LXIII

RECORD OF B. R. IN SILENT READING AFTER PRACTICE

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
6.....	1:04	1.0	4	3.0	1:53 (before practice)
6.....	:13	5.0	3	2.0	1:11 (after practice)
		Gain 400 per cent		Loss 33 per cent	
7.....	:47	1.3	2	1.5	1:31 (before practice)
7.....	:18	3.4	3	2.5	:53 (after practice)
		Gain 162 per cent		Gain 67 per cent	

REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Writing Time
6.....	1:07	1.6	40.9	4:27 (before practice)
6.....	:23	4.6	34.1	1:43 (after practice)
		Gain 188 per cent	Loss 17 per cent	

SPEED

Selection	Time	Rate	Percentage of Points Correct	Writing Time
2.....	:33	3.1	30.0	2:03 (before practice)
2.....	:18	5.3	55.0	2:00 (after practice)
		Gain 71 per cent	Gain 83 per cent	
3.....	:45	2.3	26.1	2:06 (before practice)
3.....	:25	4.1	17.4	:52 (after practice)
		Gain 78 per cent	Loss 33 per cent	

Four of the types of training on this list—training in speed, training to decrease vocalization, training to increase perceptual span, and training in comprehension—were selected for experimentation, and the methods and results will be discussed in this chapter.

FIRST TYPE OF TRAINING IN SPEED

B. R., a slow reader, and W. E., a rapid reader, were selected for training in speed. A college student interested in the problems of reading was put in charge of the work.

Two types of training were given. The first was practice in short-exposure work. Four types of material were used—sense material, non-sense syllables, as HYGP, digits, as 597, and groups of the digit zero. The apparatus used was a simple form of tachistoscope in which a falling plate gave the exposure. Each kind of material was included in each period of practice. From fifteen to twenty minutes were devoted daily to this work.

In addition to the foregoing work the subject was given training in rapid reading. From fifteen to twenty minutes were given in each practice period to this kind of reading. The directions given were to the effect that the reading was to be done rapidly, even at the expense, if necessary, of comprehension. This rapid reading was followed by a test of comprehension, which consisted either of oral or of written reproduction. The practice continued for twenty days in each case.

TABLE LXIV

RECORD OF W. E. IN SILENT READING AFTER PRACTICE

		ANSWERING QUESTIONS			
Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
5.....	:14	5.6	5	4.0	3:32 (before practice)
5.....	:06	13.0	5	3.0	1:42 (after practice)
		Gain 132 per cent		Loss 25 per cent	
6.....	:14	4.6	5	2.5	4:05 (before practice)
6.....	:06	10.8	5	1.5	2:21 (after practice)
		Gain 135 per cent		Loss 40 per cent	
7.....	:21	3.0	5	4.0	1:39 (before practice)
7.....	:10	6.2	5	3.0	.... (after practice)
		Gain 107 per cent		Loss 25 per cent	

Tables LXIII and LXIV give the results in silent reading for each subject. The reading was of various types—reading for

answering questions, for reproduction, and for speed. Tables LXV and LXVI show the material read during the different practice

TABLE LXV

MATERIAL READ AND RATES ATTAINED BY B. R. IN PRACTICE PERIOD

Selections	Reading Rate
"Little Thumb," Riverside Fourth Reader	4.1
Boy Scouts' Hand Book	5.5
"Midget," Riverside Sixth Reader	4.6
"Midget," Riverside Sixth Reader	4.6
"The Enchanted Horse," Riverside Fifth Reader	3.7
"Johnny Darter," Alexander Fourth Reader	5.1
"A Narrow Escape," Carpenter and Baker Language Reader, Sixth Year	3.2
"A Narrow Escape," Carpenter and Baker Language Reader, Sixth Year	3.4
Skipper, Carpenter and Baker Language Reader, Fourth Year	5.5
Skipper, Carpenter and Baker Language Reader, Fourth Year	5.8
"A New Teacher and a Bad Boy," Horace Mann Fifth Reader	4.5
"Twin Babies," Spaulding and Bryce Fifth Reader	6.2
"Twin Babies," Spaulding and Bryce Fifth Reader	5.2
"Opeechee," Jones Sixth Reader	6.5

TABLE LXVI

MATERIAL READ AND RATES ATTAINED BY W. E. IN PRACTICE PERIOD

Selections	Reading Rate
"Northern Europe," Youth's Companion Series	7.0
"The Colonists and the Revolution"	4.1
"Little Thumb," Riverside Fourth Reader	10.4
"Midget," Riverside Sixth Reader	8.3
"Midget," Riverside Sixth Reader	8.6
"Midget," Riverside Sixth Reader	10.6
"Midget," Riverside Sixth Reader	8.9
"Midget," Riverside Sixth Reader	8.7
"In the Factory," Riverside Seventh Reader	7.5
"In the Factory," Riverside Seventh Reader	7.5
"The Enchanted Horse," Riverside Fifth Reader	9.4
"A Narrow Escape," Carpenter and Baker Language Reader, Sixth Year	3.3
Carpenter and Baker Language Reader, Sixth Year	7.4
Carpenter and Baker Language Reader, Sixth Year	6.1

periods, together with the rate attained with each passage. These tables show clearly that B. R. makes very large improvement in rate of reading, the greatest increase being 400 per cent and the

smallest 71 per cent. The results for comprehension are not so uniform. However, it must be remembered that the training did not emphasize the meaning element in reading. In three cases there is a distinct loss and in two a distinct gain. The record of W. E. is equally interesting and shows increase in rate for every test, while, on the other hand, there is a loss in each case in the matter of comprehension.

Records were taken for span of perception before and after practice. The results are given in Table LXVII.

TABLE LXVII

RECORD OF B. R. AND W. E. IN PERCEPTION BEFORE AND AFTER PRACTICE

No. of Words Exposed	Average No. of Words Correct—B.R.		Average No. of Words Correct—W.E.	
	Before Practice	After Practice	Before Practice	After Practice
2.....	2.0	1.7	2.0	2.0
3.....	1.0	2.0	3.0	2.7
4.....	1.3	1.8	4.0	4.0
5.....	1.3	2.3	4.3	4.7
6.....	1.6	1.8	5.6	6.0

These results in perception show that no striking change was made in the span of attention. Perhaps the period of training was too brief, or perhaps Whipple (44) is right in holding that it is impossible to increase the span of attention by practice. Later experiments, it may be remarked, show that results different from those here obtained with a pupil from the sixth grade are secured if younger pupils are put through the same type of training.

Three months after the practice ended these boys were given the same tests which were given before and after practice, except that the speed tests were omitted. The purpose of this repeated test was to determine in what degree their increase in efficiency was permanent.

Tables LXVIII and LXIX give results in these tests. Both subjects lose in the rate of reading when preparing to answer questions, while B. R. has the same rate for the reproduction test as he had at the time the practice was finished. On the comprehension

side B. R. shows a distinct loss in reproduction, while W. E. shows a loss in questions answered. However, the important fact to be noted here is that the losses which were sustained in rate do not

TABLE LXVIII

RECORD OF B. R. IN SILENT READING AFTER A PERIOD OF THREE MONTHS

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
6.....	:47	1.0	2	1.5	1:31 (before practice)
6.....	:18	5.0	3	2.5	:53 (after practice)
6.....	:16	4.0	4	2.5	:40 (interval after practice)
		Loss 20 per cent		0	

REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Writing Time
6.....	1:07	1.6	40.9	4:32 (before practice)
6.....	:23	4.6	34.1	1:43 (after practice)
6.....	:23	4.6	13.5	2:30 (interval after practice)
		0	Loss 60 per cent	

TABLE LXIX

RECORD OF W. E. IN SILENT READING AFTER A PERIOD OF THREE MONTHS

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
6.....	:14	4.6	5	2.5	4:05 (before practice)
6.....	:06	10.8	5	1.5	2:21 (after practice)
6.....	:09	7.2	5	.5	:24 (interval after practice)
		Loss 33 per cent		Loss 67 per cent	

in any case carry the reader back to the point at which he started before the practice period. Possibly it should also be emphasized again that, while there are losses in comprehension, yet the training did not deal with this phase of reading.

Another check on the effect of the practice was secured by taking a record of the eye-movements. Table LXX gives the number of

TABLE LXX

EYE-MOVEMENT RECORDS OF B. R. AND W. E. BEFORE AND AFTER PRACTICE

(Selection 6)

B. R.			W. E.		
Average No. of Pauses	Average Length of Pauses	Average No. of Regressive Movements	Average No. of Pauses	Average Length of Pauses	Average No. of Regressive Movements
15.5	15.4	4.5 (before practice)	4.6	11.0	1.0 (before practice)
6.1	12.6	1.2 (after practice)	4.6	11.5	.8 (after practice)
8.4	.....	1.2 (interval after practice)	5.4	.....	1.5 (interval after practice)

pauses and regressive movements. A very decided decrease in the number of pauses and regressive movements is seen in the record of B. R. after practice. A decrease is also to be noted in the length of the pauses. No great change is made by W. E. in his record, and this probably indicates that he did not work up to the standard which he had attained in the practice period. After the interval of three months B. R. had lost 37 per cent, as shown by the number of pauses, but the number of regressive movements have not decreased. In this test W. E. does not show results as good as in either of the other tests.

A CONTROL EXPERIMENT

It may be argued by some that the later results in these cases are to be attributed to the regular school training as much as to the special training given in reading. It is true also that a part of the improvement may be due to the fact that the same material was used both before and after practice.

As a check on these matters two other boys from the same grade, one a good reader and the other a poor reader were given the same tests that they had taken earlier in the year. These tests were also the same as those taken by B. R. and W. E. before and after

practice. Subject 30 did not take reproduction test on account of lack of time.

Tables LXXI and LXXII give results for these subjects. In both cases there is, indeed, an increase in speed for every test, but

TABLE LXXI

RECORD OF SUBJECT NO. 30 IN SILENT READING BEFORE AND AFTER A PERIOD OF THREE MONTHS

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
5.....	:13	6.0	5	4.0	1:53 (before interval)
5.....	:11	7.0	5	3.5	1:12 (after interval)
		Gain 17 per cent		Loss 13 per cent	
6.....	:14	4.6	4	4.0	1:39 (before interval)
6.....	:11	6.0	5	3.0	1:18 (after interval)
		Gain 30 per cent		Loss 25 per cent	
7.....	:13	4.8	5	4.0	1:43 (before interval)
7.....	:12	5.1	5	3.0	1:13 (after interval)
		Gain 6 per cent		Loss 25 per cent	

SPEED

Selection	Time	Rate	Percentage of Points Correct	Writing Time
2.....	:18	5.3	55.0	2:58 (before interval)
2.....	:13	7.3	65.0	2:29 (after interval)
		Gain 38 per cent	Gain 18 per cent	
3.....	:23	4.5	13.0	1:54 (before interval)
3.....	:15	7.0	23.9	1:15 (after interval)
		Gain 56 per cent	Gain 84 per cent	

the increase shown is not so great as in the case of W. E. and B. R. The results for comprehension are quite similar to those for W. E. and B. R.—that is, in some cases there is a loss and in others there is a gain.

Tables LXXIII and LXXIV give data regarding the eye-movements of the same individuals before and after the interval.

TABLE LXXII

RECORD OF SUBJECT NO. 29 IN SILENT READING BEFORE AND AFTER A PERIOD OF THREE MONTHS

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
5.....	:19	4.1	4	1.0	1:50 (before interval)
5.....	:20	3.9	4	2.0	1:03 (after interval)
		Loss 5 per cent		Gain 100 per cent	
6.....	:29	2.3	5	4.0	2:39 (before interval)
6.....	:18	3.6	4	4.0	1:06 (after interval)
		Gain 56 per cent		0	
7.....	:30	2.1	4	2.5	1:47 (before interval)
7.....	:23	2.7	2	2.0	:34 (after interval)
		Gain 29 per cent		Loss 20 per cent	

REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Writing Time
6.....	:57	1.8	36.3	6:09 (before interval)
6.....	:36	2.9	50.0	2.41 (after interval)
		Gain 61 per cent	Gain 38 per cent	

SPEED

Selection	Time	Rate	Percentage of Points Correct	Writing Time
2.....	:26	3.6	45.0	2:30 (before interval)
2.....	:18	5.2	25.0	1:16 (after interval)
		Gain 44 per cent	Loss 44 per cent	
3.....	:42	2.5	0.0	:32 (before interval)
3.....	:30	3.4	0.0	:46 (after interval)
		Gain 36 per cent		

It will be seen from this that there is but little change in this phase of their reading. This result emphasizes the fact that the decrease which appeared in the records of B. R. on page 153 is due in a large degree to the practice which he had received.

TABLE LXXIII

EYE-MOVEMENT RECORDS OF SUBJECT NO. 29 BEFORE AND AFTER A PERIOD OF THREE MONTHS

Selection	Average No. of Pauses	Average No. of Regressive Movements	Selection	Average No. of Pauses	Average No. of Regressive Movements
6.....	6.3	1.1 (before interval)	7.....	6.6	1.1 (before interval)
6.....	7.8	.5 (after interval)	7.....	6.6	.6 (after interval)

TABLE LXXIV

EYE-MOVEMENT RECORDS OF SUBJECT NO. 30 BEFORE AND AFTER A PERIOD OF THREE MONTHS

Selection	Average No. of Pauses	Average No. of Regressive Movements	Selection	Average No. of Pauses	Average No. of Regressive Movements
6.....	5.8	.5 (before interval)	7.....	6.3	1.3 (before interval)
6.....	6.6	.4 (after interval)	7.....	5.8	1.2 (after interval)

The positive results of the training may be summarized as follows:

1. Such training results in marked increases in the rate of reading.

2. The decreases in rate of reading which are to be noted after a lapse of three months do not carry the reader back to the point at which he started before practice.

3. Only slight increases in rate are to be noticed in readers who have not been trained. Hence the increase in the rate of subjects who have been trained may be regarded as due to the practice given.

4. The increase in rate, as seen in the reading of W. E. and B. R. after practice, is accompanied by a marked decrease in the number of eye pauses per line.

The negative results may be summarized now as follows:

1. Such training as that described does not change comprehension in any material way.

2. Such training does not increase the span of attention for sixth-grade children.

SECOND TYPE OF TRAINING IN SPEED

In this part of the work two slow readers were selected, one of whom left school, on account of sickness, before the training was completed. The subject who finished the experiment was a fifth-grade girl (No. 20). The tutor in this case was a college student.

The period of practice was from fifteen to twenty minutes per day for twenty days. Speed was the aim here, at the expense of comprehension, if necessary. Nevertheless, comprehension was always checked up by oral reproduction. The practice differs from that given in the preceding experiment in that no short-exposure work was given. The material for the training was carefully selected, so as not to be too difficult and yet to require considerable effort on the part of the reader. Table LXXV gives the results obtained by having the subject take the same tests before and after practice.

In every test there is a very decided improvement in speed. In only two of the tests is there any decrease in comprehension, and in each case this loss is on the most difficult test of the series. If the percentage of increase in rate of D. E., in Table LXXV, is compared with the percentage of increase in rate for B. R. and W. E., on page 152, it will be seen that with one exception the gains made by D. E. compare favorably with those of B. R. and W. E.

The positive result of this experiment may be stated as follows: Training in rapid reading without training in perception produces as marked increase in the rate of reading as when both types of training are given.

The negative result of this work may be stated as follows: A decrease in comprehension is to be noted in certain tests given. Such a decrease is found only in the more difficult work.

TRAINING FOR INCREASE IN SPAN OF ATTENTION

In the drill work for speed which was described at the beginning of the chapter two kinds of practice were given—short-exposure drill and reading for speed. The next type of drill to be described

is that in which short exposure is used alone. The same material and same short-exposure apparatus described on page 149 were used. The purpose here was to determine whether such practice will increase the length of the perceptual span for children of the

TABLE LXXV

RECORD OF A SUBJECT BEFORE AND AFTER PRACTICE IN SPEED READING

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
4.....	:27	2.5	5	3.5	2:31 (before practice)
4.....	:15	4.6	5	4.0	1:36 (after practice)
		Gain 84 per cent		Gain 14 per cent	
5.....	:46	1.7	5	2.0	2:15 (before practice)
5.....	:17	4.6	4	3.0	:59 (after practice)
		Gain 171 per cent		Gain 50 per cent	
7.....	:51	1.2	5	2.0	2:27 (before practice)
7.....	:16	3.8	3	.5	:43 (after practice)
		Gain 217 per cent		Loss 75 per cent	

REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Writing Time
5.....	:52	2.0	35.0	2:43 (before practice)
5.....	:25	4.1	35.0	1:24 (after practice)
		Gain 105 per cent	0	
7.....	1:16	1.8	26.5	2:21 (before practice)
7.....	:28	4.8	20.6	1:41 (after practice)
		Gain 167 per cent	Loss 22 per cent	

fourth grade. The subjects for Whipple's work in an experiment of the same kind were adults, and our own earlier results (page 151) show that such drill is not effective in the sixth grade; it was therefore thought worth while to try the same kind of work with much younger children. Two subjects were used, one a girl and the other

a boy, both from the fourth grade. It may be added that these children had shown a limited perceptual span in the earlier experiments.

Tables LXXVI and LXXVII give results in these tests. For No. 17 there is a decided increase in every case, while in the record of No. 15 there is an increase in every case, except in the six-word series, and here the two averages are the same.

TABLE LXXVI

RECORD OF SUBJECT NO. 15 BEFORE AND AFTER SHORT-EXPOSURE PRACTICE

Average on 2 Words	Average on 3 Words	Average on 4 Words	Average on 5 Words	Average on 6 Words	Average on 7 Words
1.8	2.5	2.5	3.0	3.3	Omitted (before practice)
2.0	3.0	4.0	4.3	3.3	3.5 (after practice)

TABLE LXXVII

RECORD OF SUBJECT NO. 17 BEFORE AND AFTER SHORT-EXPOSURE PRACTICE

Average on 2 Words	Average on 3 Words	Average on 4 Words	Average on 5 Words	Average on 6 Words	Average on 7 Words
1.3	1.0	1.6	1.5	2.2	2.0 (before practice)
2.0	3.0	4.0	3.9	3.3	3.5 (after practice)

In considering these results it should be remembered that the practice given was the same as in the case of the sixth-grade boys whose negative results are reported on page 151. Attention may be called also to the fact that the practice work was done with a fall-exposure apparatus, while the original and final series were given with the apparatus described on page 139. This eliminates to a large degree the element of adjustment to the apparatus and makes the marked increase in the perceptual span the more significant. The importance of a wide span of attention, as shown in the preceding chapter, makes this result all the more valuable. It seems that positive results can be obtained if the training is undertaken as early as the fourth year. In the light of these facts it may be repeated here that without doubt the type of training which is given in primary work by means of the flash cards is a very important element in the early training in reading. It is also clear that

the foregoing results indicate the desirability of a better grading and control of such work. Incidentally the result makes it clear that training must come at the time in a child's development when it can produce results. Late training is often not effective.

TRAINING IN COMPREHENSION

Another problem attacked was that of measuring the effect of practice in comprehension. Two subjects were used—one a fourth-grade boy and the other a sixth-grade boy. Both subjects had shown in the oral- and silent-reading tests that they were not efficient in comprehension. The tutor was a college student.

TABLE LXXVIII

RECORD OF SUBJECT NO. 14 BEFORE AND AFTER TRAINING IN COMPREHENSION

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
4.....	:41	1.7	5	3.5	2:33 (before practice)
4.....	:21	3.3	5	3.0	2:28 (after practice)
		Gain 94 per cent		Loss 14 per cent	
5.....	:46	1.7	5	2.5	2:19 (before practice)
5.....	:31	2.5	5	4.5	2:20 (after practice)
		Gain 47 per cent		Gain 80 per cent	

REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Writing Time
4.....	1:06	1.9	20.0	3:31 (before practice)
4.....	:55	2.3	44.0	4:32 (after practice)
		Gain 21 per cent	Gain 120 per cent	

The training here consisted in reading selections carefully with a view to emphasizing those elements on which the meaning depended. Such matters were discussed as topic sentences, relational words, effect of different types of modifying phrases, etc.

In short, an attempt was made to give the subjects a feeling for language. Such practice was continued for twenty days. The time for each day was from twenty to thirty minutes. Tables LXXVIII and LXXIX give results in this work.

TABLE LXXIX

RECORD OF SUBJECT NO. 27 BEFORE AND AFTER TRAINING IN COMPREHENSION

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
6.....	:35	1.8	5	3.0	2:38 (before practice)
6.....	:19	3.4	5	2.5	1:06 (after practice)
		Gain 89 per cent		Loss 17 per cent	
7.....	:16	3.7	5	2.5	3:32 (before practice)
7.....	:18	3.4	5	1.5	1:37 (after practice)
		Loss 8 per cent		Loss 40 per cent	

REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Writing Time
6.....	:35	3.0	54.4	4:47 (before practice)
6.....	:25	4.2	40.9	3:16 (after practice)
		Gain 40 per cent	Loss 25 per cent	
8.....	1:10	1.7	50.0	5:03 (before practice)
8.....	:42	2.9	41.6	4:25 (after practice)
		Gain 71 per cent	Loss 17 per cent	

The positive results of this work may be summarized as follows:

1. Training in comprehension increases the rate of reading.

2. A gain in comprehension is made in two tests by one subject. These gains are greater than any which have been seen in the previous experiments.

The negative results may be summarized as follows: A loss in comprehension is shown in one test by No. 14 and in all the tests by No. 27. The results of the latter subject may be due to his attitude, which was reported by his instructor as adverse to the

training. Comment on these results is hardly needed. One is impressed with the fact that, like much of our school work, training accomplishes only a part of what it aims to secure.

TRAINING TO REDUCE VOCALIZATION

Another type of practice given was concerned with the decrease of vocalization during silent reading. Two subjects, Nos. 16 and 28, who showed this habit in a marked degree, were selected for this practice work. The instructor was a college student.

TABLE LXXX

RECORD OF SUBJECT NO. 28 BEFORE AND AFTER PRACTICE IN THE DECREASE OF VOCALIZATION

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
6.....	:32	1.9	4	1.5	1:23 (before practice)
6.....	:34	1.9	3	1.5	:44 (after practice)
7.....	:45	1.3	2	2.0	1:27 (before practice)
7.....	:17	3.6	1	.5	.... (after practice)
		Gain 177 per cent		Loss 75 per cent	

REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Writing Time
6.....	1:10	1.5	36.3	3:49 (before practice)
6.....	:27	3.9	36.2	2:12 (after practice)
		Gain 160 per cent	Loss 0.2 per cent	
8.....	1:11	1.7	18.7	3:25 (before practice)
8.....	:38	3.2	0.0	0:00 (after practice)
		Gain 88 per cent	Loss 100 per cent	

The practice given here was begun with an explanation of some of the difficulties to which a large degree of vocalization makes the reader susceptible. The subjects were told to read in their natural way, except that they were to read without vocalization. Comprehension was tested either with oral questions or with oral reproduc-

tions. That the practice was effective was shown by the fact that no vocalization was noted when the subjects took the final tests. Their instructor reported that at first there was considerable distraction caused by the attempts to eliminate the vocalization. There was, however, a gradual decrease in this distraction, and before the end of the practice period the reactions of the children seemed perfectly normal. The practice continued for twenty days. The length of time for each day was from twenty to thirty minutes. The results obtained by having the subjects take the same tests before and after practice are shown in Tables LXXX and LXXXI.

TABLE LXXXI

RECORD OF SUBJECT NO. 16 BEFORE AND AFTER PRACTICE IN THE DECREASE OF VOCALIZATION

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
4.....	:28	2.5	5	4.5	6:12 (before practice)
4.....	:17	4.0	4	4.0	3:28 (after practice)
		Gain 60 per cent		Loss 11 per cent	
5.....	:53	1.5	5	4.5	4:15 (before practice)
5.....	:46	1.7	5	4.0	2:40 (after practice)
		Loss 13 per cent		Loss 11 per cent	

REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Writing Time
4.....	1:09	1.8	28.0	4:50 (before practice)
4.....	:51	2.5	48.0	6:04 (after practice)
		Gain 39 per cent	Gain 71 per cent	

The positive results of this experiment may be summarized as follows:

1. Training in reading without vocalization results in a marked decrease in this motor accompaniment of reading.

2. Training of the type mentioned above results in an increase in rate. In considering these results for gain in rate it should be remembered that the practice work was done at the normal rate.

The negative results may be summarized as follows:

1. In five of the seven tests taken by the two subjects there is a loss in comprehension; in one of the tests no change is shown in the results for comprehension; and in one test there is a gain.

These results indicate that vocalization in the case of these children was a help in comprehension and that when it was removed there is a decrease in comprehension. It would be very interesting to know whether further practice would decrease the handicap under which such pupils work in being deprived of their vocalization. It is possible that the mental activity of children proceeds in a large measure in terms of vocal reactions and that the process of abridging these reactions must be a slow and gradual process.

TRAINING IN PHONICS

Attention has already been called to the fact that certain pupils have difficulty with reading because their visual vocabulary is very much limited—that is, they do not recognize words easily and readily, and they have no methods at hand by which they can acquire new words. Two third-grade boys who had this type of difficulty were given training in phonics. The practice work did not include any reading. The results obtained by having subjects take the same tests both before and after practice are shown in Tables LXXXII and LXXXIII.

The positive results obtained by such training may be summarized as follows:

1. In six of the seven tests taken by the two subjects there is an increase in rate.

2. In one test there is an increase in comprehension.

The negative results may be summarized as follows:

1. In one of the tests there is a decrease in rate.

2. In five of the tests there is a loss in comprehension.

By way of general summary of the whole chapter it may be commented:

1. That while the results given in the chapter cannot be considered as final, and there is a very great need of more work with a larger number of children, yet it is quite clear that speed, comprehension, and vocalization can be changed and modified in a positive direction by practice. It is true also that the perceptual span can be increased if the training is given early in the child's school life.

TABLE LXXXII

RECORD OF SUBJECT NO. 5 BEFORE AND AFTER PRACTICE IN PHONICS

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
3.....	:32	1.7	3	2.0	:47 (before practice)
3.....	:17	3.2	5	1.5	2:37 (after practice)
		Gain 88 per cent		Loss 25 per cent	
4.....	:38	1.8	5	4.0	1:36 (before practice)
4.....	:26	2.6	5	5.0	.... (after practice)
		Gain 44 per cent		Gain 25 per cent	

REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Writing Time
2.....	:29	2.1	68.8	.... (before practice)
2.....	:22	2.8	53.1	.... (after practice)
		Gain 33 per cent	Loss 23 per cent	

2. That it was evident in the training that there is need of a careful technique for the different types of practice and that especially trained instructors are a necessity if such training is to be carried very far.

3. That it is an open question as to just how far certain types of training should be carried, as shown by the falling off in comprehension in many cases.

4. That rate lends itself to improvement by different methods. Such an increase can be brought about by training in rapid reading,

by training in decreasing vocalization, by training in phonics, and by training in comprehension. In three of these methods speed in reading was not emphasized, and yet in each case there is a marked increase in rate. In other words, it seems that if the attention of the reader is directed to any one of these four phases of the reading process the result is an increase in rate.

TABLE LXXXIII

RECORD OF SUBJECT NO. 1 BEFORE AND AFTER PRACTICE IN PHONICS

ANSWERING QUESTIONS

Selection	Time	Rate	Questions Attempted	Questions Correct	Writing Time
3.....	:30	1.8	5	3.0	:58 (before practice)
3.....	:36	1.5	5	2.0	1:16 (after practice)
		Loss 17 per cent		Loss 33 per cent	
4.....	:30	2.3	4	3.0	1:03 (before practice)
4.....	:29	2.4	4	2.5	1:50 (after practice)
		Gain 4 per cent		Loss 17 per cent	

REPRODUCTION

Selection	Time	Rate	Percentage of Points Correct	Writing Time
2.....	:32	1.9	62.5	.... (before practice)
2.....	:28	2.2	25.0	1:41 (after practice)
		Gain 16 per cent	Loss 60 per cent	
3.....	:52	.6	20.0	.... (before practice)
3.....	:36	.8	20.0	1:19 (after practice)
		Gain 33 per cent	0	

The permanence of an increase in rate produced by training in rapid reading is marked. It appears that after a lapse of three months there was a slight decrease in rate, yet such a decrease does not take the subject back to the point at which he began before the practice.

Such an increase in rate can best be explained by saying that the subject whose rate is increased learns to work at a higher level

of attention. The effect is an increase in the span of attention. That the span of attention is increased when the rate is increased is shown in the eye-movement records of B. R., as reported in the first experiment of this chapter. These records show a marked decrease in the number of pauses for this subject after training, which means that he makes use of a greater span of attention in his reading. That such an increase in the span of attention is possible is shown by the fact that in Table XXXVIII his average number of pauses per line is 15.5. This is less than a word per pause. His span of attention as shown in Table XLVIII is between one and two words. From this he should be able to read a ten-word line in seven or eight pauses. The training given such persons in reading seems to show them new possibilities as to their ability in reading. One boy expressed this thought when he said, "I have just found out that I can read fast."

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APPENDIX

READING SELECTIONS USED IN THE DIFFERENT TESTS AND EXPERIMENTS

ORAL-READING TESTS: PROSE

(Tables III–V A)

Directions to the pupil.—On a few of the pages which follow this there are some short prose selections. I want you to read them *orally*. Read as you do when you are called upon by your teacher to read. *Do not turn any pages until I ask you to do so.*

After this there were given the standard oral-reading tests by W. S. Gray, from *Studies of Elementary-School Reading through Standardized Tests* (Supplementary Educational Monographs, published in conjunction with the *School Review* and the *Elementary School Journal*), Vol. I, No. 1, p. 33.

ORAL-READING TESTS: POETRY

(Tables III, IV, VI, VI A)

To the pupil.—The next selections are poetry. These are to be read *orally*. Again, read as you do when your teacher calls upon you to read.

1

Early every morning
A birdie sings to me,
"Get up! Get up! Up, up!"
As plain as plain can be.

Swinging in the blossoms,
He makes the blossoms snow,
Singing, "Up! Get up! Up, up!
O sleepy head, you're slow!"

Does a birdie ever sing to you
In the morning?
A birdie sings to me
Early every morning.

2

The Frost looked forth one still, clear night,
And whispered, "Now I shall be out of sight;
So through the valley and over the height
In silence I'll take my way.
I will not go on like that blustering train—
The wind and the snow, the hail and the rain—
Who make so much bustle and noise in vain;
But I'll be as busy as they."

Then he flew to the mountain and powdered its crest;
He lit on the trees, and their boughs he dressed
With diamond beads; and over the breast
Of the quivering lake he spread
A coat of mail, that it need not fear
The downward point of many a spear
That he hung on its margin, far and near,
Where a rock could rear its head.

3

No! those days are gone away,
And their hours are old and gray,
And their minutes buried all
Under the down-trodden pall
Of the leaves of many years;
Many times have winter's shears,
Frozen North, and chilling East,
Sounded tempests to the feast
Of the forest's whispering fleeces,
Since men knew nor rent nor leases.

No, the bugle sounds no more,
And the twanging bow no more;
Silent is the ivory shrill
Past the heath and up the hill;
There is no mid-forest laugh,
Where lone Echo gives the half
To some wight, amazed to hear
Jesting deep in forest drear.

4

There was a sound of revelry by night,
And Belgium's capital had gathered then
Her Beauty and her Chivalry, and bright
The lamps shone o'er fair women and brave men.

A thousand hearts beat happily; and when
Music arose with its voluptuous swell,
Soft eyes looked love to eyes which spake again,
And all went merry as a marriage bell;
But hush! hark!—a deep sound strikes like a rising knell!

Did ye not hear it?—No; 'twas but the wind,
Or the car rattling o'er the stony street;
On with the dance! let joy be unconfined;
No sleep till morn, when Youth and Pleasure meet
To chase the glowing Hours with flying feet—
But, hark!—that heavy sound breaks in once more,
As if the clouds its echo would repeat,
And nearer, clearer, deadlier than before!
Arm! arm! it is—it is the cannon's opening roar!

ORAL-READING TEST: ORATORY

(Tables III, IV, VII, VII A)

To the pupil.—The next selection is taken from an oration. Read it aloud.

With regard to the high aristocratic spirit of Virginia and the southern colonies, it has been proposed, I know, to reduce it by declaring a general enfranchisement of their slaves. This project has had its advocates and panegyrists, yet I never could argue myself into any opinion of it. Slaves are often much attached to their masters. A general wild offer of liberty would not always be accepted. History furnishes few instances of it. It is sometimes as hard to persuade slaves to be free as it is to compel freemen to be slaves; and in this auspicious scheme we should have both these pleasing tasks on our hands at once. But when we talk of enfranchisement, do we not perceive that the American master may enfranchise too, and arm servile hands in defense of freedom?—a measure to which other people have had recourse more than once, and not without success, in a desperate situation of their affairs.

SILENT-READING TESTS: ANSWERING QUESTIONS ON PROSE

(Tables IX–XI A)

To the pupil.—The next selections are prose. You are to read them *silently*. Read them only *once*, but read *carefully*. You will be expected to answer questions upon each selection in turn.

1

It is a cold day. A little boy is playing in the snow. He looks into the tree. He sees a bird's nest. The nest and the tree are covered with snow. The boy plays in the snow under the tree.

To the pupil.—Write upon the following sheet in the spaces left the answers to the questions. Use *complete sentences* in your answers.

1. What kind of a day is it?
2. What is the little boy doing?
3. What is in the tree?
4. What covers the tree?
5. Where does the little boy play?

2

Ned and Ruth are playing in the attic. Ned has a fire-engine. He likes to hear the bell ring. He has a big red wagon. He puts his ladders in the wagon. He plays a house is on fire. Ned runs very fast to the fire.

1. Where are Ned and Ruth playing?
2. What has Ned?
3. Where does he put the ladders?
4. What is he playing?
5. How does he go to the fire?

3

On the steep hillside grew a tall ash tree. Right on the bank of the rushing brook it grew. Its branches spread far out across the little stream. Its leaves looked down into the flashing water. There, when the sun shone brightly, they saw leaves looking up at them. They called these "water leaves."

1. Where did the ash tree grow?
2. How far did its branches spread?
3. Where did the leaves look?
4. What did they see when the sun shone?
5. What did they call these leaves?

4

Switzerland is a land of mountains and valleys and many beautiful lakes and rivers. Most of the people live in the valleys and keep cattle, sheep, and goats. In the springtime thousands of cattle are driven into the mountains to stay all summer. Many of the people go up into the mountains too. The men and boys take care of the cattle, and the women make butter and cheese.

1. Of what is Switzerland made up?
2. Where do most of the people live?
3. What do they do for a living?
4. What happens in the springtime?
5. How do the people divide the work?

5

The Amazon River is in South America. It is the longest and largest river in the world. During the rainy season it is not unlike a great inland sea. In the dry season, when the stream is at its lowest, vast sand banks crop up here and there, above the water, and line the shores on either side. The greater part of its course is through a wild forest, and there are no great cities upon its banks.

1. Where is the Amazon River?
2. Compare it with other rivers.
3. Describe it in the rainy season.
4. Describe it in the dry season.
5. Describe its course.

6

The walrus is a flesh-eating animal, feeding mostly upon shellfish and worms, and is therefore generally found in the shallow waters along a coast line, diving for its food on banks which lie at a depth of from two to twenty fathoms below the surface. Deeper than that the walrus does not care to go; in fact, it generally feeds in about fifteen fathoms.

1. What kind of an animal is the walrus?
2. What does it eat?
3. Where is it found?
4. How does it get its food?
5. How deep does it go?

7

The tall, solid walls of the great stone castles in which the Norman barons lived betoken an age of violence and suspicion. Beauty gave way to the needs of safety. Girdled with its green and slimy ditch, round the inner edge of which ran a parapeted wall, pierced along the top with shot holes, stood the buildings, spreading often over many acres.

1. In what did the Norman barons live?
2. What kind of an age was this?
3. To what did beauty give way?
4. What surrounded the castles?
5. How large were the buildings?

8

Go with me to Philadelphia as she was a hundred years ago. Observe and watch the movements, listen attentively to the words, look steadfastly at the countenances, of the men who compose the little congress assembled there. Braver, wiser, nobler men have never been gathered and grouped under a single roof, in any age, on any soil beneath the sun.

1. What place and time are mentioned?
2. What is assembled at this place?
3. What are we to observe about this group of men?
4. Was this a large body of men?
5. Describe the men.

9

The qualities that made Holland great were the qualities of the common people. The ideal character of the Dutch race is not an exceptional genius, but a plain, brave, straightforward, kind-hearted, liberty-loving, law-abiding citizen—a man with a healthy conscience, a good digestion, and a cheerful determination to do his duty in the sphere of life to which God has called him. Let me try to etch the portrait of such a man in a few and simple lines. Grant me but six strokes for the picture.

1. What qualities made Holland great?
2. What are the characteristics of the Dutch citizen?
3. What kind of determination does the Dutch citizen have?
4. What is said of his conscience?
5. How many strokes does the author require for a picture of this man?

10

The sincere respect for education which is typical of the American spirit is not a result of education. It is a matter of intuitive belief, of mental character, of moral temperament. First of all, the sure conviction that every American child ought to have the chance to go to school, to learn to read, to write, to think; second, the general notion that it is both fair and wise to make an open way for every one who is talented and ambitious to climb as far as he can and will in the higher education; third, the vague feeling that it will be the credit and benefit of democracy, not only to raise the average level of intelligence, but also to produce men and institutions of commanding excellence in learning and science and philosophy—these are the three elements which you will find present in varying degrees in the views of typical Americans in regard to education.

1. What is the attitude of the American toward education?
2. What is the origin of this attitude?
3. What chance should every child have?
4. Why should the level of intelligence be raised?
5. Who should be allowed the advantages of a higher education?

SILENT-READING TEST: ANSWERING QUESTIONS ON POETRY

(Tables XII–XIV A)

To the pupil.—The next selections are poetry. Read them *silently* and only *once*, but read *carefully*. You will answer questions upon each selection as before.

1

My Grandpa says that long ago,
Before he was a man,
His Grandma told my tales to him
As only grandmas can.

And long before he was a boy,
In lands across the sea,
The boys and girls were told the tales
That now he tells to me.

So when my Grandpa reads a tale
Or tells a tale to me,
I know it is as old, as old,
As old as it can be.

To the pupil.—Write upon the following sheet in the spaces left the answers to the questions. Use *complete sentences* in your answers.

1. Who is talking in this poem?
2. What other people are mentioned?
3. What countries are mentioned?
4. What does Grandpa do?
5. What kind of stories does he tell?

2

Once, in a rough, wild country,
On the other side of the sea,
There lived a dear little fairy,
And her home was in a tree.
A dear little, queer little fairy,
And as rich as she could be.

To northward and to southward,
She could overlook the land,
And that was why she had her house
In a tree, you understand.
For she was the friend of the friendless,
And her heart was in her hand.

And when she saw poor women
Patiently, day by day,
Spinning, spinning, and spinning
Their lonesome lives away,
She would hide in the flax of their distaffs
A lump of gold, they say.

1. Where did the fairy live?
2. What kind of a fairy was she?
3. In what directions could she look from her home?
4. What did the fairy give to the people?
5. What kind of people did the fairy help?

3

And there was tumult in the air,
The fife's shrill note, the drum's loud beat,
And through the wide land everywhere
The answering tread of hurrying feet,
While the first oath of freedom's gun
Came on the blast from Lexington;
And Concord, roused, no longer tame,
Forgot her old baptismal name,
Made bare her patriot arm of power,
And swelled the discord of the hour.

With its shade of elm and oak
The church of Berkely Manor stood;
There Sunday found the rural folk
And some esteemed of gentle blood.
In vain their feet with loitering tread
Passed 'mid the graves where rank is naught;
All could not read the lesson taught
In that republic of the dead.

1. What could be heard in the air?
2. What came from Lexington?
3. What church is mentioned?
4. Where did the people go on Sunday?
5. What is meant by "republic of the dead"?

4

It little profits that, an idle king,
By this still hearth, among these barren crags,
Match'd with an aged wife, I mete and dole
Unequal laws unto a savage race,
That hoard, and sleep, and feed, and know not me.
I cannot rest from travel: I will drink
Life to the lees; all times I have enjoy'd
Greatly, have suffer'd greatly, both with those
That loved me, and alone; on shore, and when
Thro' scudding drifts the rainy Hyades
Vext the dim sea: I am become a name;
For always roaming with a hungry heart
Much have I seen and known; cities of men
And manners, climates, councils, governments,
Myself not least, but honor'd of them all;
And drunk delight of battle with my peers,
Far on the ringing plains of windy Troy.
I am a part of all that I have met.

1. What kind of a wife did the king have?
2. What did this king do?
3. What experiences had he had?
4. What things had he seen?
5. Why did the king have a hungry heart?

SILENT-READING TEST: REPRODUCTION

(Tables XV–XVII A)

To the pupil.—The next selections are prose. Read each one in its turn *silently*, *carefully*, and but *once*. You will be expected to write the story.

1

How big and strong the fire horses are! The firemen are good to their horses. The horses stand a long time in the engine-house. When they hear the alarm, they run to the engine. Down drops the harness! The firemen spring upon the engine. Then away go the big strong horses! When they come to the fire, they are not frightened. They stand still while the firemen work.

To the pupil.—Write on the following sheet the story you have just read. If you cannot remember the words used in the story, use your own words.

2

The ox was hungry. He went to the barn, and put his head down into the manger. "Bow-wow! Bow-wow!" snapped a little black dog right under his nose. "Come," said the ox, "you must get out of my manger. You do not eat hay." "Bow-wow!" snapped the dog; but he did not get up. "Bow-wow! Bow-wow-wow!" At last the ox turned away.

3

In a short time the tent was up, beds were made, and lobster soup was ready for supper. Fan and I didn't like soup, so we ate raw lobsters and clams. Everybody was so glad to be on land that eating soup with clam shells for spoons, sleeping on beds of leaves, and hearing wolves howl were not hardships at all.

4

One night, soon after Daisy-Fair came to town, the moon was very, very bright, and of course you have not forgotten how much the flowers liked to hear stories on moonlight nights. So, when they asked the Lady Petunia to tell them one, she smiled and said, "I will tell you why the sunflowers hang their heads. Once upon a time, when the earth mother was busy taking care of her seed children—long, long ago, when the world was very new—a redbird brought her two small brown seeds and told her to take good care of them. "If they are brave seeds and grow their best, they shall have blossoms like the sun and almost as beautiful," said the redbird, and then flew quickly away.

5

On the fifth of November, which was the beginning of summer in those parts, the weather being very hazy, the seamen spied a rock within half a cable's length of the ship; but the wind was so strong, that we were driven directly upon it, and immediately split. Six of the crew, of whom I was one, having let down the boat into the sea, made a shift to get clear of the ship and the rock. We rowed, by my computation, about three leagues, till we were able to work no longer, being already spent with labor while we were in the ship.

6

Robin Hood on one occasion sent a present to Queen Katherine with which she was so pleased that she swore she would be a friend to the noble outlaw as long as she might live. So one day the queen went to her chamber and called to her a page of her company and bade him make haste and prepare to ride to Nottinghamshire to find Robin Hood in Sherwood Forest; for the queen had made a match with the king, her archers against his archers, and the queen proposed to have Robin Hood and his band to shoot on her side against the king's archers.

7

The "medicine bag" is a mystery bag; and its meaning and importance necessary to be understood, as it may be said to be the key to Indian life and Indian character. These bags are constructed of the skins of animals, of birds, or of reptiles, and are ornamented and preserved in a thousand different ways, as suits the tastes or freak of the person who constructs them. These skins are generally attached to some part of the clothing of the Indian, or carried in his hand. They are oftentimes decorated in such a manner as to be exceedingly ornamental to his person, and always are stuffed with grass, or moss, or something of the kind; and generally without drugs or medicines within them, as they are religiously closed and sealed, and seldom, if ever, to be opened.

8

After a month's struggle, Mr. Pitts purchased the ground on which his home was to be built. It was an indescribable hillside, bordering on the precipitous. A friend of mine remarked that "it was such an aggravating piece of profanity that the owner gave Mr. Pitts five dollars to accept the land and the deed to it." This report I feel bound to correct. Mr. Pitts purchased the land. He gave three dollars for it. The deed having been properly recorded, Mr. Pitts went to work. He borrowed a shovel, and, perching himself against his hillside, began loosening the dirt in front of him, and spilling it out between his legs, reminding me, as I passed daily, of a giant dirt-dauber.

9

The high stimulation of will-power in America has had the effect of quickening the general pace of life to a rate that always astonishes and sometimes annoys the European visitor. The movement of things and people is rapid, incessant, bewildering. There is a rushing tide of life in the streets, a nervous tension in the air. Business is transacted with dispatch and close attention. The preliminary compliments and courtesies are eliminated. Whether you want to buy a paper of pins, or a thousand shares of stock, it is done quickly. I remember that I once had to wait an hour in the Ottoman Bank at Damascus to get a thousand francs on my letter of credit. The courteous director gave me coffee and delightful talk. In New York the transaction would not have taken five minutes—but there would have been no coffee nor conversation.

RAPID SILENT-READING TEST

(Tables XXI–XXIII A)

To the pupil.—The next selections are prose. They are to be read *silently just as rapidly as you can read.*

You will be expected to write the story of the selections, but remember that the emphasis is on how *rapidly you can read.*

1

This is the farmer's wheat field. The sun shone brightly. The rain fell softly. The wheat grew tall and golden. Now the wheat is ready to reap. See, the wind bows down the golden grain. The farmer will reap the wheat and take it to the mill.

To the pupil.—Write on the following sheet the story which you have just read. If you cannot remember the words in the story, use your own words.

2

A man and a lion once traveled together. Each one boasted of his own strength, as if he were greater than the other. As they were disputing, they passed a stone statue, which stood near the road. It represented a lion killed by a man. "See," said the man, "how strong we men are! Even the king of beasts must yield to us." "That sounds very well," replied the lion. "Was it a lion who made the statue, or a man? Perhaps we would have told a different story."

There are two sides to everything.

3

I believe we can nowhere find a better type of a perfectly free creature than in the common house fly. Not free only, but brave; and irreverent to a degree which I think no human republican could by any philosophy exalt himself to. There is no courtesy in him; he does not care whether it is king or clown whom he teases; and in every step of his swift mechanical march, and in every pause of his resolute observation, there is one and the same expression of perfect egotism, perfect independence and self-confidence, and conviction of the world's having been made for flies.

4

Nitetis, a beautiful young princess, the daughter of Amasis, king of Egypt, had, for political reasons, been betrothed to Cambyses, king of the Medes and Persians, and most powerful monarch of his time. After bidding a final adieu to her parents and friends and all that her heart held dear, she had started with a brilliant retinue of followers on the long journey to Babylon, the home of her intended husband. She was accompanied by her father's friend Croesus, the old and wealthy king of Lydia, who acted in the capacity both of tutor and guardian; and everything was done that power or skill could devise to make the journey by sea and land delightful and easy.

SILENT-READING TEST: OUTLINING

(Tables XVIII–XX A)

To the pupil.—The next selections are prose. You are to read these *silently*. Read each one *once*, but read *carefully*.

You will be expected to write out what you consider to be the main points in each selection.

1

The blood carries food for the body. After leather, yarn, and cloth are manufactured, they are not stored away and locked up in factories, but are sent out over the country by railroads, canals, and rivers to cities, towns, and villages, so that the people who need them can find and use them.

In the same way, after our food is manufactured into blood, it does not remain in the factory, but is sent out to all parts of the body, so that it can be used in building them up and repairing them.

Instead of railroads, canals, and rivers, we have running through our bodies a system of little tubes; and instead of railroad trains and canal boats, we have the warm red blood flowing through these tubes, loaded with material the body needs to build it up. In your chest is the heart, a muscular pump, which works without ceasing day and night as long as you live, and forces the blood through all of the blood tubes, even to the very tips of your fingers and toes.

To the pupil.—Write on the following sheet the *main points* which you have obtained from the preceding selection. Number them 1, 2, 3, etc., if you care to.

2

We started off about noon; a goodly band of some eight or nine striplings, with two or three hammers, and a few pence among us, and no need to be home before dusk. An October sun shone merrily out upon us; the fields, bared of their leaves, had begun to be again laid under the plow, and long lines of rich brown loam alternated with bands of yellow stubble, up and down which toiled many a team of steaming horses. The neighboring woods, gorgeous in their tints of green, gold, and russet, sent forth clouds of rooks, whose noisy jangle, borne onward by the breeze, and mingling with the drone of the bee and the carol of the lark, grew mellow in the distance, as the cadence of a far-off hymn. We were too young to analyze the landscape, but not too young to find in every feature of it intensest enjoyment. Moreover, our path lay through a district rich in historic associations.

3

The simplest attempts to form monopolies consist of agreements between a number of producers to limit the product, to maintain fixed prices, or to appoint common selling-agents. These agreements are seldom lived up to, and mutual suspicion among the members generally breaks them up. Yet a "friendly agreement" between four large beef packers in Chicago has sufficed to build up a practical monopoly of the cattle and meat business of the United States. In other cases, where the number of parties to the agreement has been small, this form of combination has created virtual monopolies. A second and more formal organization is the "pool." This is established by a formal agreement to maintain prices, in which the parties agree to divide the territory, to divide the business, or to divide the earnings. Pools have been common in the railroad business, but have existed elsewhere, as in cases where nominally competing gas companies agree to serve separate districts in a city, and not to encroach upon each other's territory. Pools have often enough been broken up by the mutual distrust of the members; for, if one party to the pooling agreement breaks it while the others keep their promises, he may make large profits.

SILENT-READING TEST: DIRECTION TEST

(Tables XXV, XXV A)

To the pupil.—On the next sheet you are told to do a number of very simple things. Do these *just as rapidly* as you can. The emphasis is upon *speed.*

This was followed by Woodworth and Wells' direction test, from *Psychological Review Monograph Supplement,* Vol. XIII, No. 5, p. 71.

COURTIS SILENT-READING TEST

(Tables XXVI, XXVI A)

Directions given orally. *Manual of Instructions for Giving and Scoring the Courtis Standard Tests* (rev. ed. 1914. Issued by the Department of Co-operative Research, Detroit), p. 80, Test 4, "Normal Reading."

NEWSPAPER TEST

(Tables XXIV, XXIV A)

To the pupil.—For your next work you will be given a newspaper. At some place in this paper there is a short article entitled, "Lincoln Statue Ready to Adorn Illinois Capitol." You are to find this article *as quickly as* possible.

VOCALIZATION TESTS: PRONOUNCING EASY WORDS

(Tables XXXII, XXXIII, and XXXIV)

To the pupil.—On the next sheet there is a list of words taken from the material which you have already read. You are to pronounce these words just as *rapidly* as you can.

Easy words: 1. wagon, house, snow, spirit, wind, strut, feast, spear, frost, before, delight, spoke, early, body, general, crown, region, reason, maple, nest, night, stroll, woods, found, king, milk, mouse, home, dog, boy.

The same words were given a second time in the reverse order, and a third time in an entirely different order.

COUNTING TEST

(Tables XXXII, XXXIII, and XXXIV)

To the pupil.—The next work is very simple and very easy. You are to count as *rapidly* as you can for 30 seconds as follows: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; etc.

SELECTIONS USED IN EYE-MOVEMENT EXPERIMENTS[1]

Selection	Reader	Page	Lines
	SILENT READING		
1	First	55	1– 8
2	Second	93	1–10
3	Third	45	12–20
4	Fourth	99	1–12
5	Fifth	59	12–22
6	Sixth	159	11–23
6A	Sixth	45	9–23
7	Seventh	165	18–26
8	Eighth	84	8–22
	ORAL READING		
1	First	40	1– 8
2	Second	45	1–10
3	Third	14	5–13
4	Fourth	93	11–24
5	Fifth	55	10–22
6	Sixth	48	4–18
7	Seventh	166	9–19
8	Eighth	83	3–16

[1] References to "Riverside Series" of readers. Houghton Mifflin Co.

SELECTIONS USED IN BREATHING EXPERIMENTS[1]

Selection	Reader	Page	Lines
1	First	64	1–23
2	Second	47	1–22
3	Third	68	1–26
4	Fourth	60	1–22
5	Fifth	29	1–23
6	Sixth	63	1–20
7	Seventh	36	21–19
8	Eighth	138	13–29
		139	1– 3

SAMPLE MATERIAL FOR PERCEPTION TESTS

PERCEPTION TESTS: EASY SENTENCES

(Tables XLVIII, XLVIII)

I

1. Pick flowers.
2. The wind sings.
3. I will help you find it.

PERCEPTION TEST: NON-SENSE MATERIAL

(Table LVIII)

1. C H P D
2. R D P X H
3. Z K W H B M
4. K C Q L S

PERCEPTION TEST: DIGITS

(Table LVII)

1. 59
2. 734
3. 8732
4. 259182

PERCEPTION TEST: GROUPINGS OF ZERO

(Table LIX)

1. oooo
   oooo
2. oooooo
3. oooo oooo oooo
4. oooooo
   oooooo
   oooooo
   oooooo

[1] Reference to "Riverside Series" of readers. Houghton Mifflin Co.

PERCEPTION TEST: VOICE-EYE SPAN

(Tables L–LV)

The underlined words indicate the points at which the light was cut off in the experimental work.

> I'll make a big scarecrow and stand it up in the cherry tree. That will do it. I'll have an old coat on that scarecrow and an old hat on its head. They will make it look like a man, and that will scare the robins.

Seven other selections were used, each more difficult than the preceding one.[1]

PERCEPTION TEST: SILENT READING

(Table LVI)

Selections to determine range of attention in silent reading.

Once upon a time there were a little old woman and a little old man. One day the little old woman made a boy out of gingerbread. She put it into the oven to bake. By and by she opened the oven door to see if it was done. Out jumped the Gingerbread Boy! Away he ran, out of the door and down the road. The little old woman and the little old man ran. . . . .

Seven other selections were used, each more difficult than the preceding one.[1]

REPRODUCTION TEST

ORAL READING: WRITTEN REPRODUCTION[2]

(Table XXIX)

To the pupil.—The next selections are to be read *silently*, *carefully*, and but *once*. After you have finished reading the selection

[1] References not available.

[2] Reference to "Riverside Series" of readers. Houghton Mifflin Co.

you will be expected to *tell* the story. If you do not remember the exact words use words of your own.

Selection	Reader	Page	Lines
2.....	Second	79	1–12
3.....	Third	157	1–14
4.....	Fourth	229	1–18
5.....	Fifth	61	5–22
6.....	Sixth	12	18–27
		13	1– 8
7.....	Seventh	101	1–15
8.....	Eighth	98	1–17

SUBJECT LISTENS TO SELECTION READ.

WRITTEN REPRODUCTION[1]

(Table XXIX)

To the pupil.—For your next work you will listen carefully while a short selection is read to you. When the selection is finished you will be expected to write the story. If you do not remember the exact words use words of your own.

Selection	Reader	Page	Lines
2.....	Second	116	1–12
3.....	Third	180	13–24
		181	1– 2
4.....	Fourth	150	3–16
5.....	Fifth	198	8–18
6.....	Sixth	95	1–14
7.....	Seventh	8	18–28
		9	1– 4
8.....	Eighth	149	1–20

LANGUAGE TEST: OPPOSITE TEST

(Table XXX)

To the pupil.—On the next sheet is a list of twenty words. I wish you to write after each word another word that has the opposite meaning. For example, if one word were *far*, you could write as its opposite, *near*. Work as rapidly as you can.

[1] References to "Riverside Series" of readers. Houghton Mifflin Co.

The following reference gives the test: W. H. Pyle, *The Examination of School Children* (New York: Macmillan), "Opposite Tests," p. 29, I, II.

GENUS-SPECIES TEST

(Table XXX)

To the pupil.—On the next sheet is a list of twenty words. These words are class-names. I wish you to name an example or species under the class. For example, if one word were *food*, you could name *bread*, or if one word were *clothing*, you could write *coat*, etc.

Work as rapidly as possible.

The following reference gives the test: W. H. Pyle, *The Examination of School Children* (New York: Macmillan), p. 30.

PART-WHOLE TEST

(Table XXX)

To the pupil.—On the next sheet is a list of twenty words each of which names the whole of something. I wish you to write after each word a word which names a part of the thing. For example, if one word were *engine*, you could write *wheel*. If one word were *foot*, you could write *toe*, etc.

Work as rapidly as possible.

The following reference gives the test: W. H. Pyle, *The Examination of School Children* (New York: Macmillan), pp. 31, 32.

COMPLETION TEST

(Table XXX)

To the pupil.—The next selections have been written with certain words left out. You are to put in a word wherever a blank occurs. If the following sentence should occur, "The .....is falling.....and.....," you might make it read, "The snow is falling thick and fast." Be careful to put in only one word for each blank and see that your sentences have meaning. In a few places parts of words are given and a blank is put in for the remainder, that is, "he.....might be heard....."

Work as rapidly as possible.

The following reference gives the first test used: M. R. Trabue, *Completion Test Language Scales* (Teachers College, Columbia University, Contributions to Education), No. 77, Scale D, p. 23.

The second test is as follows:

An.....Fox fell into a.....and cried out for..... A Wolf heard .....and looked down to.....what the.....was.

"Ah!" said the....., "pray lend a....., friend, and get me.....of this."

"Poor....," said the Wolf, "how did.....come about? How..... have you been.....? You must be very....."

"Come, come,".....the Fox, "this is no.....for plying and..... questions. Get me.....of the well....., and I will.....you all..... it afterward."

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